

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Theodore Bydalek, *et al.*
Serial No. : 10/712,611
Filed : November 13, 2003
For : FASTENER ASSEMBLY
Art Unit : 3677
Examiner : JEFFREY ANDREW SHARP

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I hereby certify that this correspondence
is being transmitted to the United States
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2007.

Jonathan G. Riley

Registration No. 58,625

PETITION TO THE DIRECTOR UNDER 37 C.F.R. § 1.181(a)(2)

Dear Director:

Applicants respectfully submit this petition under 37 C.F.R. § 1.181 to review the Examiner's objection under 35 U.S.C. § 132. Specifically, Applicants seek review of the Examiner's objection that the replacement sheet containing Fig. 30, submitted on February 28, 2007 contains new matter in violation of 35 U.S.C. § 132.

This petition is filed within two months of the mailing date of the Office Action, dated May 17, 2007, and is therefore timely. Applicants believe that no fee is due; however, the Director is authorized to charge any required fees or credit any overpayment to Deposit Account 502318.

Statement of Facts

This Application relates to a fastener and was filed on November 13, 2003 with Claims 1-47. Claims 1-47 have since been canceled via an Amendment accompanying an RCE mailed on June 14, 2006. Presently Claims 48-63 and 67-69 are pending. See 02-28-2007 Amendment, Pg. 2-5. This Petition relates specifically to Claims 58-63, and 67-69.

The Claims concern the “body” of a fastener assembly with an annular bearing surface. As the Examiner has acknowledged, Applicants clearly disclosed a body with a “frustoconcial” annular bearing surface located on the lower side of the body. See 11-13-2003 Specification, Fig. 11; see also 11-13-2003 Specification, Pg. 7, ll. 22-28. Applicants also disclosed that the annular bearing surface could be spherically shaped in addition to being frustoconical in shape. See 11-13-2003 Specification, Pg. 7, ll. 22-28. In the Office Action of August 31, 2006 the Examiner initially objected to the drawings under 37 C.F.R. § 1.83(a) alleging that “the ‘annular bearing surface on the body is spherically convex’ must be shown or the feature(s) canceled from the claim(s).” See 08-31-06 Office Action, Pg. 3, ll. 13-14. The Examiner explicitly stated that there was support for this limitation and that it could be found in Paragraph 0061. Id. The Examiner further stated that the drawings failed to show this embodiment (the annular bearing surface on the body as spherically convex in shape as opposed to being frustoconical in shape). Id. Based on this assertion, the Examiner objected to the figures and requested corrected drawing sheets showing the annular bearing surface on the body as spherically convex in shape in order to avoid abandonment of the Application. Id. at Pg. 3, ll. 18-19.

Though Applicants disagreed that the drawings needed to be amended (Applicants’ position was that the Specification fully supported all pending Claims), Applicants amended Figure 30 in order to put the Application in condition for allowance. Specifically, in response to the Examiner’s request, Figure 30 was amended to show the annular bearing surface on the body as spherically convex. See 02-28-2007 Amendment, Pg. 23. Amended Figure 30 introduced no new matter because the drawing was fully supported by the specification, as the Examiner himself concluded. See 11-13-2003 Specification, Pg. 7, ll. 22-28; see also 08-31-2006 Office Action, Pg. 3, ll. 15-17.

In the Office Action mailed on May 17, 2007, the Examiner objected to Figure 30 on grounds that the spherically shaped annular bearing surface located on the “lower side of the body” constituted new matter. See 05-17-2007 Office Action, Pg. 2, ll. 12-13. Specifically, the Examiner objected to amended Figure 30 under 35 U.S.C. § 132, stating “it [Fig. 30] introduced new matter into the disclosure.” Id. The Examiner further stated:

The added material which is not supported by the original disclosure is as follows: the location of the spherical annular bearing surface on the body was not previously disclosed. Therefore, the new replacement sheet effectively introduces matter, which previously has not been disclosed by illustrating a particular location for the annular bearing surface having a spherically convex shape—said location being a lower side of the body. See 05-17-2007 Office Action, Pg. 2, ll. 14-19.

Though Figure 30 disclosed a frustoconically-shaped annular bearing surface located on the lower side of the body and though Applicants’ originally-filed specification disclosed that the frustoconically shaped annular bearing surface on the lower side of the body could be spherically shaped, the Examiner persisted in maintaining that Applicants’ amended Figure 30 constituted new matter.

Points to be Reviewed

Applicants request that the Director review the following two points. First, whether the Examiner’s actions requiring the Applicants to amend the drawings (to disclose a “fully supported element”) and then objecting to Applicants’ amended drawing under 35 U.S.C. § 132 is arbitrary and capricious. Second, whether amended Figure 30 constitutes new matter in violation of 35 U.S.C. § 132.

- I. In requiring the Applicants amend the drawings to show the “fully supported” annular bearing surface as spherically convex and then rejecting amended Figure 30 as new matter, the Examiner acted arbitrarily and capriciously and abused his discretion.**

The Examiner’s action is arbitrary and capricious. Over Applicants’ objection, the Examiner insisted that Figure 30 be amended to show a “spherically” convex annular bearing surface and then objected on new matter grounds because Applicants had followed

the Examiner's directive and illustrated a spherically shaped annular bearing surface. The Examiner simply acted unreasonably, arbitrarily, and capriciously.

On one hand, the Examiner assured Applicants that support for the spherically convex limitation "is found in originally filed paragraph [0061]." Apparently, Applicants needed only to conform a portion of the written description ("paragraph 0061") and Figure 30. See M.P.E.P. 2163.06 ("stated another way, information contained in any one of the specification, claims or drawings of the application as filed may be added to any other part of the application without introducing new matter."); see also Application of Heinle, 52 C.C.P.A. 1164, 1173 (C.C.P.A. 1965).

However, when Applicants complied with the Examiner's request, the Examiner reversed course and made a new matter objection. Apparently, support for the spherically convex limitations was not "found in originally filed paragraph [0061]." Putting to one side whether Figure 30 needed to be amended and whether amended Figure 30 was fully supported by the originally-filed specification, Applicants simply cannot make sense of the Examiner's action. If Applicants must amend Figure 30 to show a spherically convex annular bearing surface on the fastener body, Applicants have no clue where it should be shown in order to satisfy the Examiner's unusual demands in this case. Plainly, the capped side of the body is not appropriate, nor is the torque transmitting surface, shaped to transmit torque, an appropriate location for a spherically shaped surface. See 02-28-2007 Amendment, Pg. 23. The Examiner placed Applicants in an impossible situation: the "supported" limitation must be shown in the drawings but when shown constitutes new matter. The Examiner's contradictory positions represent an abuse of discretion. The Examiner's action should be reversed with instructions to explain how the "supported" spherically convex limitation can be shown without adding new matter.

II. Amended Figure 30 is fully supported by the Specification and is not new matter in violation of 35 U.S.C. § 132.

The Specification, as filed, fully supports the claim limitation, "the annular bearing surface on the body is spherically convex in shape" as recited in Claims 58, 60, and 62. According to the Specification, "in alternative embodiments, the annular surface 72 is

spherically concave or spherically convex.” See 11-13-2003 Specification, Pg. 7, ll. 24-26. In fact, the Examiner stated that the originally filed Specification supports “the annular bearing surface on the body is spherically convex.” See 08-31-2006 Office Action, Pg. 3, ll. 13-17 (stating “support for this limitation is found in originally filed paragraph [0061]; however, the originally filed drawings fail to show this embodiment.” Accordingly, the Specification fully supports Claims 58-63, and 67-69, and no new matter was introduced via the amended Figure 30.

In response to the initial request by the Examiner, Applicants, in a good faith, attempted to place the Application in condition for allowance by submitting amended Figure 30. Amended Figure 30 was fully supported by the specification. According to the Specification, the body cooperates with the object being fastened. See 11-13-2003 Specification, Pg. 10, ll. 6-7. As shown in amended Figure 30, the surface that cooperates with the object being fastened is depicted as the annular bearing surface on the body. See 02-28-2007 Amendment, Pg. 23. As such, one of ordinary skill in the art would recognize that the annular bearing surface is located on the “lower side” of the body, as was shown in amended Figure 30.

The Specification makes clear that the annular surface is located adjacent to the torque transmitter. See 11-13-2003 Specification, Pg. 7, ll. 22-24. Plainly, if the annular surface is “adjacent” to the torque transmitter, the annular surface cannot be located “on” the torque transmitter itself. See 02-28-2007 Amendment, Pg. 23.

Similarly, the Specification also makes clear that the other “locations” are unsuitable for the annular bearing surface. In the originally-filed specification, the cap is retained on the retaining surface of the body. See 11-13-2003 Specification, Pg. 12, ll. 1-2. Clearly, the cap retaining surface, ultimately covered with a cap, would simply not represent an appropriate location for an annular bearing surface. As such, one of ordinary skill in the art would recognize the location of the annular bearing surface as clearly shown in amended Figure 30.

III. Conclusion

Applicants submit that the Examiner's actions in requiring amended drawings showing the fully supported annular bearing as spherically convex and then objecting to amended Figure 30 is arbitrary and capricious. Further, amended Figure 30, as depicted in the replacement sheet filed on February 28, 2007, does not introduce new matter in violation of 35 U.S.C. § 132. As such, Applicants respectfully request that the Director exercise his authority to reverse the Examiner's drawing and 35 U.S.C. § 132 objections and remand this case with instructions to provide Applicants with guidance regarding how the annular bearing surface can be shown in the drawings without introducing new matter.

Dated: July 17, 2007

Respectfully Submitted,

By: 

Dana Andrew Alden
(Reg. No. 46,475)

The Alden Law Group, L.L.P.
2122 York Road, Suite 180
Oak Brook, Illinois 60523
P: (630) 368-7676
F: (630) 368-7677

05-17-2007 OFFICE ACTION



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,611	11/13/2003	Theodore Bydalek	11-9540-6520-0000-2	9015
7590	05/17/2007			
Dana Andrew Alden MacLean-Fogg Company 1000 Allanson Road Mundelein, IL 60060				EXAMINER
				SHARP, JEFFREY ANDREW
ART UNIT		PAPER NUMBER		
		3677		
MAIL DATE		DELIVERY MODE		
		05/17/2007 PAPER		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/712,611	BYDALEK ET AL.
	Examiner Jeffrey Sharp	Art Unit 3677

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 28 February 2007.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 48-63 and 67-69 is/are pending in the application.
 - 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 48-63 and 67-69 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 2/28/2007 is/are: a) accepted or b) objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) <input type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____
3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____	5) <input type="checkbox"/> Notice of Informal Patent Application
	6) <input type="checkbox"/> Other: _____

DETAILED ACTION

[1] This action is responsive to Applicant's remarks/amendment filed on 28 February 2007 with regard to the Official Office action mailed on 31 August 2007.

Status of Claims

[2] Claims 48-63, and 67-69 are pending.

Drawings

[3] The drawing(s) were previously objected for informalities. Applicant submitted a replacement sheet on 28 February 2007 to address claimed subject matter (spherically convex annular bearing surface) not shown.

The amendment filed 28 February 2007 is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: the location of the spherical annular bearing surface on the body was not previously disclosed. Therefore, the new replacement sheet effectively introduces matter, which previously has not been disclosed by illustrating a particular location for the annular bearing surface having a spherically convex shape -- said location being a lower side of the body.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Objections/Double Patenting

[4] Claims 62 and 63 were previously objected to because they are substantial duplicates of claims 58 and 59, respectively. Applicant has persuasively argued this issue in the response filed on 28 February 2007. Claim 62 further limits "shaped according to the grooved body" of claim 58, by "shaped, at least in part, to fit within the groove on the body".

Accordingly, after further consideration, the objections to claims 62 and 63 for double patenting have been withdrawn.

Claim Rejections - 35 USC § 112

[5] The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

[6] Claim 60 was previously rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicant has successfully addressed the issue(s) of indefiniteness in the amendment filed on 28 February 2007 by eliminating the confusion to whether or not an element was missing. Accordingly, the rejection of claim 60 under 35 U.S.C. 112, second paragraph is withdrawn.

Claim Rejections - 35 USC § 103

[7] The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

[8] Claims 58-63 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Becker US-4,143,578 in view of any one of Crowther US-1,940,675 or Zorn et al. US-4,240,670 or GB 2051285 A.

In short, Becker teaches a fastener assembly (10) comprising a body (12) being configured as a nut and having a torque transmitter (hexagonal profile) and threads (24), and a cap (14) retained on the body (12), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (26). The body (12) has an annular bearing surface (18) adjacent a generally cylindrical surface (30).

However, Becker fails to disclose expressly, the annular bearing surface (18) to be generally spherically convex.

Crowther suggests on page 2 lines 116-119, that a spherically convex annular bearing surface for a nut is an *obvious variant* of a conical bearing surface in the art. Therefore, Crowther suggests that a spherically convex bearing surface is an obvious art-recognized equivalent to Becker's conical bearing surface, and that one of ordinary skill in the art would instantly recognize this modification.

Zorn et al. suggest on column 3 lines 48-49, a generally spherically convex annular bearing surface (48). The generally spherical convex shape of the annular bearing surface allows the surrounding washer (52) to expand radially outwardly after torque is applied to the nut, and to facilitate frictional engagement between the washer and its mating workpiece (12').

GB 2051285 A suggests a generally spherically convex annular bearing surface (16) for self-centering purposes.

Therefore, at the time of invention, it would have been obvious to one of ordinary skill in the art to modify the annular bearing surface (18) taught by Becker, to be generally spherically convex as suggested by Zorn et al., in order to cause radially outward expansion of a surrounding washer. In the alternative, it would have also been obvious to one of ordinary skill in the art to substitute the annular bearing surface (18) taught by Becker, for a generally spherically convex annular bearing surface, since Crowther deems the two to be art-recognized equivalents. Lastly, it would have been obvious to one of ordinary skill in the art to modify the annular bearing surface (18) taught by Becker, to be generally spherically convex as suggested by GB 2051285A, in order to improve the self-centering function of the fastener assembly, especially when in engagement with a washer.

Response to Arguments/Remarks

[9] Claims 48-50, 52, 54, 55, and 56 were previously rejected under 35 U.S.C. 102(b) as being anticipated by GB 2179416 A.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[10] Claims 48-50, 52-54, 55, 56, and 60 (as understood), were previously rejected under 35 U.S.C. 102(b) as being anticipated by FR 633186 A.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[11] Claims 48-50, 52, 54, and 56 were previously rejected under 35 U.S.C. 102(b) as being anticipated by Becker US-4,143,578.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[12] Claims 48-52, 54, and 56 were previously rejected under 35 U.S.C. 102(b) as being anticipated by Masuda et al. US-4,557,654 (figures 7 and 8).

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[13] Claims 48-50, 52, and 54-56 were previously rejected under 35 U.S.C. 102(b) as being anticipated by Hobson et al. US-4,427,326.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[14] Claims 48-50, 52, 54, 55, and 56 were previously rejected under 35 U.S.C. 102(b) as being anticipated by Liffick US-3,960,047.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[15] Claims 48, 49, 51, 52, 56, and 57 were previously rejected under 35 U.S.C. 102(b) as being anticipated by Espey et al. US-5,350,266.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are moot in view of the following new grounds of rejection.

[16] Claims 58-63 were previously rejected under 35 U.S.C. 103(a) as being obvious over Becker US-4,143,578 in view of any one of Crowther US-1,940,675, or Zorn et al. US-4,240,670, or GB 2051285 A.

Applicant's arguments/remarks with regard to this rejection have been fully considered, but are not persuasive for at least the reasons mentioned above. In short, the Examiner does not see how one of ordinary skill in the art would not be motivated to modify a body to have a spherically convex bearing surface in view of the Crowther, Zorn et al., and GB 2051285 A reference. It is not required that the prior art disclose or suggest the properties newly-discovered by an applicant in order for there to be a *prima facie* case of obviousness. See *In re Dillon*, 919 F.2d 688, 16 USPQ2d 1897, 1905 (Fed. Cir. 1990). Moreover, as long as some motivation or suggestion to combine the references is provided by the prior art taken as a whole, the law does not require that the references be combined for the reasons contemplated by the inventor. See *In re Beattie*, 974 F.2d 1309, 24 USPQ2d 1040 (Fed. Cir. 1992); *In re Kronig*, 539 F.2d 1300, 190 USPQ 425 (CCPA 1976) and *In re Wilder*, 429 F.2d 447, 166 USPQ 545 (CCPA 1970). The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly

suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. *In re Keller*, 642 F. 2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). In this regard, a conclusion of obviousness may be based on common knowledge and common sense of the person of ordinary skill in the art without any specific hint or suggestion in a particular reference. *In re Bozek*, 416 F.2d 1385, 1390; 163 USPQ 545, 549 (CCPA 1969). In the instant case, it is known by those of ordinary skill in the art to put a spherical chamfer on nuts to reduce inter-rotational friction, eliminate burrs and sharp dangerous corners, and also to allow multi-axial movement with a surface.

New Grounds of Rejection

Claim Rejections - 35 USC § 112

[17] The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

[18] Claims 49-54 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

It is not clear what "left hand notch" and "right hand notch" would mean to one of ordinary skill in the art, and therefore, the scope of the claim cannot be readily ascertained. It is not clear how "left-hand" or "right hand" modifies "notch". Since a "left" and/or "right" direction is not defined, these descriptors are indefinite. It is further unclear how a "right hand" notch can be at an angle other than ninety degrees, as one of ordinary skill in the art recognizes

that a "right triangle" is a triangle formed from a ninety-degree angle. Using similar logic, a "right hand notch" would suggest a notch formed from a ninety-degree angle.

Claim Rejections - 35 USC § 102

[19] The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
- (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

[20] As they are understood, claims 48-54, 56, and 57 are rejected under 35 U.S.C. 102(b) as being anticipated by GB 2051285A.

In short, and when the claims are given their broadest reasonable interpretation, Jones generally discloses the invention as claimed, teaching a fastener assembly comprising a body (11) having a torque transmitter (13), thread (14), retaining surface (18), notch (inherent, unlabeled) on the retaining surface (18), and a cap (12) having an inner surface (19) that retains the cap (12) on the body (11) through an interference fit. As it is understood, the notch has an angle between thirty and sixty degrees, and particularly 45 degrees (shown in figure 3). The body (11) is a nut (11).

[21] As they are understood, claims 48-57 are rejected under 35 U.S.C. 102(b) as being anticipated by GB 830722.

In short, and when the claims are given their broadest reasonable interpretation, Morse generally discloses the invention as claimed, teaching a fastener assembly comprising a body (Figure 7) having a torque transmitter (120), thread (104), retaining surface (128), right/left hand notch (110,136) on the retaining surface (125), and a cap (162) having an inner surface (156) that retains the cap (162) on the body (Figure 7) through an interference fit. As it is understood, the notch has an angle between thirty and sixty degrees, and approximately 45 degrees (shown at chamfer 41, 134). The body (Figure 7) is a nut. The assembly further comprises a washer (148). The retaining surface includes a second generally cylindrical surface.

Claim Rejections - 35 USC § 103

[22] The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

[23] Claims 58, 60, 62, and 67-69 are rejected under 35 U.S.C. 102(b) as being anticipated by, or in the alternative, under 35 U.S.C. 103(a) as being unpatentable over GB 618388.

In short, and when the claims are given their broadest reasonable interpretation, Elastic Stop Nut Corporation generally discloses the invention as claimed, teaching a fastener assembly

comprising a body having a torque transmitter (10), thread (14,16), retaining surface (11), right/left hand notch (22) on the retaining surface (11), and a cap (26) having an inner surface (32) that retains the cap (26) on the body through an interference fit. As it is understood, the notch (22) has an angle between thirty and sixty degrees, and approximately 45 degrees. The body (10) is a nut (10). The retaining surface includes a second generally cylindrical surface, and the body further comprises a spherically convex bearing surface, and the groove (22) comprises a curved surface (inherent and shown). While the reference appears silent as to "stainless steel" as a material choice for the cap, it would be readily appreciated by those of ordinary skill in the art to use such a material, since caps are generally designed to be robust to the elements.

Note that it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416. It is also common knowledge to choose a material that has sufficient strength, durability, flexibility, hardness, etc. for the application and intended use of that material.

Conclusion

[24] Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the

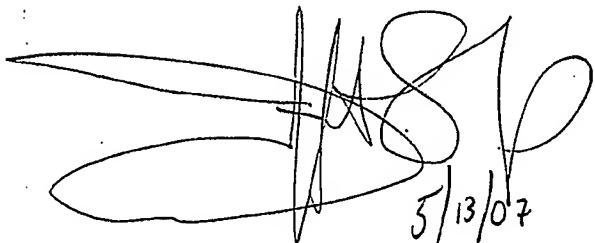
mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

[25] Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeffrey Sharp whose telephone number is (571) 272-7074. The examiner can normally be reached 7:00 am - 5:30 pm Mon-Thurs.

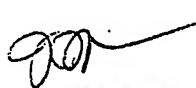
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, J.J. Swann can be reached on (571) 272-7075. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JAS



5/13/07



JJ Swann
Supervisory Patent Examiner
Technology Center 3600

02-28-2007 AMENDMENT

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Attorney Docket No. 11-9540-6520-0000-2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Theodore Bydalek, et al.

Serial No. : 10/712,611

Filed : November 13, 2003

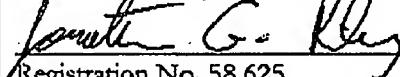
For : FASTENER ASSEMBLY

Art Unit : 3677

Examiner : JEFFREY ANDREW SHARP

I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office, Fax No. (571) 273-8300, on February 28, 2007.

Jonathan G. Riley



Registration No. 58,625

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT UNDER 37 C.F.R. § 1.111

Dear Sir:

This is responsive to the Office Action issued on August 31, 2006. A shortened statutory period for reply to this Office Action is set to expire on November 30, 2006. A petition for a THREE-MONTH extension of time is concomitantly submitted herewith, thereby extending the expiration date to February 28, 2007.

The Commissioner is authorized to charge any required fees, including any extension and/or excess claim fees, any additional fees, or credit any overpayment to Deposit Account No. 502318.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Amendments to the Drawings begin on page 6 of this paper.

Remarks/Arguments begin on page 7 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of Claims in the application:

Listing of Claims:

Claims 1-47 (Canceled)

Claim 48 (Currently Amended) A fastener assembly, comprising:

- a) a body including:
 - i) a torque transmitter; [and]
 - ii) a thread;
 - iii) a retaining surface; and
 - iv) a notch, the notch positioned on the retaining surface and located at one end of the body; and
- b) a cap retained on the body including:
 - i) an inner surface, the inner surface retains the cap on the body through an interference fit with the notch.

Claim 49 (Currently Amended) The fastener assembly according to claim 48, further comprising at least one groove on the body that, at least in part, retains the cap wherein the notch is a right hand notch.

Claim 50 (Currently Amended) The fastener assembly according to claim 49[8], wherein the cap is, at least in part, retained on the body through an interference fit the right hand notch has an angle of between 30 and 60 degrees.

Claim 51 (Currently Amended) The fastener assembly according to claim 49[8], further comprising a plurality of notches that, at least in part, retain the cap on the body wherein the right hand notch is at a 45 degree angle.

Claim 52 (Currently Amended) The fastener assembly according to claim 48, further comprising an annular bearing surface that is provided on the body wherein the notch is a left hand notch.

Claim 53 (Currently Amended) The fastener assembly according to claim 52 [48], further comprising an annular bearing surface that is provided on the body and generally spherically convex wherein the left hand notch is at an angle of between 30 and 60 degrees.

Claim 54 (Currently Amended) The fastener assembly according to claim 52 [48], further comprising an annular bearing surface that is located on the body adjacent to a generally cylindrical surface wherein the left hand notch is at a 45 degree angle.

Claim 55 (Previously Presented) The fastener assembly according to claim 48, further comprising a washer.

Claim 56 (Previously Presented) The fastener assembly according to claim 48, wherein the body is a nut.

Claim 57 (Currently Amended) The fastener assembly according to claim 48, wherein, at least a portion of the torque transmitter is fashioned into a plurality of notches that, at least in part, retain the cap the retaining surface includes a second surface that is generally cylindrical.

Claim 58 (Previously Presented) A fastener assembly, comprising:

- a) a body including a torque transmitter and an annular bearing surface;
- b) the torque transmitter is generally hexagonal in shape and provided with a groove;
- c) the groove, at least in part, retains a cap on the body;
- d) the cap includes a stainless steel material and is shaped according to the grooved body; and

- e) the annular bearing surface on the body is spherically convex in shape.

Claim 59 (Previously Presented) The fastener assembly according to claim 58, wherein the annular bearing surface is located adjacent to a generally cylindrical surface.

Claim 60 (Previously Presented) A fastener assembly, comprising:

- a) a body including a torque transmitter and an annular bearing surface;
- b) the torque transmitter includes a groove that, at least in part, retains a cap on the body;
- c) the cap includes a stainless steel material and is shaped according to the grooved body so that when the body is torqued an interference fit is achieved between the cap and the body; and
- d) the annular bearing surface on the body is spherically convex in shape.
- e)

Claim 61 (Previously Presented) The fastener assembly according to claim 60, wherein the annular bearing surface is located adjacent to a generally cylindrical surface.

Claim 62 (Previously Presented) A fastener assembly, comprising:

- a) a body including a torque transmitter and an annular bearing surface;
- b) the torque transmitter is generally hexagonal in shape and provided with a groove;
- c) the groove, at least in part, retains a cap on the body;
- d) the cap includes a stainless steel material and is shaped, at least in part, to fit within the groove on the body; and
- e) the annular bearing surface on the body is spherically convex in shape.

Claim 63 (Previously Presented) The fastener assembly according to claim 62, wherein the annular bearing surface is located adjacent to a generally cylindrical surface.

Claim 64 (Cancelled)

Claim 65 (Cancelled)

Claim 66 (Cancelled)

Claim 67 (New) The fastener assembly according to claim 58, wherein the groove includes a curved surface.

Claim 68 (New) The fastener assembly according to claim 60, wherein the groove includes a curved surface.

Claim 69 (New) The fastener assembly according to claim 62, wherein the groove includes a curved surface.

Amendments to the Drawing:

Applicants submit a Replacement Sheet for the newly amended Figure 30. Per Examiner's suggestion, the amended Figure 30 now includes an annular bearing surface on the body that is spherically convex in shape. The amended Figure 30 is now consistent with the Specification. No new matter is introduced.

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Remarks/ArgumentsStatus of the Claims

Claims 1-47 were originally filed and were canceled. In the June 14, 2006 Amendment new Claims 48-66 were added and currently stand rejected. The present Amendment adds new Claims 67-69. The New Claims 67-69 are fully supported by the Specification. See FIG. 29. Accordingly, no new matter is introduced. Upon entry of this Amendment, Claims 48-63 and 67-69 are pending.

Applicants respectfully request reconsideration and withdrawal of rejection in view of the following Remarks/Arguments.

A. Withdrawn Claims: 37 C.F.R. § 1.142(b)

Claims 64-66 were withdrawn from consideration in the Office Action mailed August 31, 2006. The Examiner alleges Claims 64-66 are directed to a non-elected method and withdrew them from consideration pursuant to 37 C.F.R. § 1.142(b).

Without agreeing to the merits of the Examiner's rejection, and to expedite the prosecution of this Application, Applicants hereby cancel Claims 64-66, without prejudice. Applicants reserve the right to file a continuation to pursue the subject matter covered in these canceled Claims.

B. Information Disclosure Statement

Pursuant to 37 C.F.R. §§ 1.56, 1.97 and 1.98, Applicants submitted an IDS on June 19, 2006. Applicants believe the documents are relevant to the patentability of the present invention. In the August 31, 2006 Office Action, the Examiner requested that Applicants point out twenty or so the most relevant documents. Applicants note that a similar request was made in U.S. Patent Application No. 10/668, 173, a continuation of U.S. Patent No. 6,749,386 to Harris, from which this Application claims priority as a continuation-in-part. Because Applicants responded to the Examiner's request in U.S. Patent Application No. 10/668,173 by submitting a list of the most relevant documents, Applicants submit the same list of documents herewith.

1. U.S. Patent No. 292,063

18. U.S. Patent No. 3,078,899

2. U.S. Patent No. 367,196
3. U.S. Patent No. 738,217
4. U.S. Patent No. 752,628
5. U.S. Patent No. 827,562
6. U.S. Patent No. 889,593
7. U.S. Patent No. 948,326
8. U.S. Patent No. 1,015,059
9. U.S. Patent No. 1,040,215
10. U.S. Patent No. 1,140,974
11. U.S. Patent No. 1,297,845
12. U.S. Patent No. 1,622,581
13. U.S. Patent No. 1,952,305
14. U.S. Patent No. 2,210,455
15. U.S. Patent No. 2,253,241
16. U.S. Patent No. 2,783,810
17. U.S. Patent No. 2,562,032
19. U.S. Patent No. 3,417,802
20. U.S. Patent No. 3,693,685
21. U.S. Patent No. 3,851,690
22. U.S. Patent No. 3,942,570
23. U.S. Patent No. 4,339,179
24. U.S. Patent No. 4,377,361
25. U.S. Patent No. 4,812,095
26. U.S. Patent No. 4,941,787
27. U.S. Patent No. 5,141,374
28. U.S. Patent No. 5,409,338
29. U.S. Patent No. 5,984,602
30. U.S. Patent No. 6,135,689
31. U.S. Patent No. 6,776,565
32. U.S. Pub. No. 2002/0039522A1
33. German Patent No. DE 298 15 492 U1
34. German Patent No. DE 199 56 287 A1

For the Examiner's convenience, Applicants organized the above listed references, 1-34, into a supplement IDS on the attached modified PTO Form No. 1449. Because Applicants have previously submitted copies and translations of German Patents DE 298 15 492 U1 and DE 199 56 287 A1, no additional copies are submitted herewith.

It is respectfully requested the Examiner initial the supplemental IDS submitted herewith, as well as, initial all other relevant documents submitted in all prior IDSs. Applicants further respectfully request the references listed in the supplemental IDS submitted herewith be made of record and appear among the "References Cited" on any patent to issue therefrom.

Applicant believes no fees are due in with the supplemental IDS included herewith. Should any fees be due, the Commissioner is authorized to charge Deposit Account No. 502318.

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C. Double Patenting: 37 C.F.R. § 1.75

Claims 62 and 63 are objected to under 37 C.F.R. § 1.75. The Examiner alleges that Claims 62 and 63 are a substantial duplicate of Claims 58 and 59. Applicants respectfully disagree with the Examiner's objection.

It is Applicant's right to re-state, by plural claiming, his or her invention in a reasonable number of ways. Courts have consistently held that a mere difference in scope between claims would be sufficient. See M.P.E.P. § 706.03(k). As asserted by the Examiner, Claim 58 and 62 are "substantial duplicates," implying that these two claims are not exact duplicates and therefore have a difference in claim scope. Therefore, Applicants have the right to claim the invention in these two ways. Accordingly, Applicants respectfully request the Examiner's objection to be withdrawn.

D. Drawing

The drawing (i.e., Figure 30) was objected to under 37 C.F.R. § 1.83(a). The Examiner pointed out, while admitting the feature is fully disclosed in the specification, that Figure 30 does not include an annular bearing surface on the body that is spherically convex in shape.

Applicants respectfully submit a Replacement Sheet for Figure 30 showing an annular bearing surface on the body that is spherically convex in shape. No new matter is introduced.

E. Claim Rejections: 35 U.S.C. § 112

Claim 60 stands rejected under 35 U.S.C. § 112. The Examiner alleges Claim 60 is indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Per the Examiner's suggestion, Applicants delete the element "e)" from Claim 60. Accordingly, Applicants respectfully request the Examiner's objection be withdrawn.

F. Claim Rejections: 35 U.S.C. § 102

Claims 48-57 and 60-61 stand rejected under 35 U.S.C. § 102. Applicants respectfully disagree and request that the Examiner's 35 U.S.C. § 102 rejections be withdrawn.

The present invention is directed to a novel fastener assembly. In one embodiment, the invention includes a body having a torque transmitter, a thread, a retaining surface, a notch, and a cap. See Pg. 10, ll. 6-10. The notch is positioned on the retaining surface and located at one end of the body. See Pg. 6, ll. 1-5. The cap includes an inner surface retaining the cap on the body through an interference fit with the notch. See Pg. 6, ll. 21-26. In another embodiment, the invention includes a body including a torque transmitter and an annular bearing surface. See Pg. 10, ll. 6-10. The annular bearing surface is spherically convex in shape. See Pg. 7, ll. 24-26. The torque transmitter includes a groove retaining the cap on the body. See Pg. 4, ll. 23-29. The cap includes a stainless steel material and is shaped according to the grooved body so that when the body is torqued an interference fit is achieved between the cap and the body. See Pg 12, ll. 3-6.

To better present the invention and to expedite the prosecution of this Application, Applicants amended Claims 48-54, 57. No new matter is introduced.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." M.P.E.P § 2131 (citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)).

GB 2179416 A

The Examiner alleges Claims 48, 49, 50, 52, 54, 55 and 56 are anticipated by GB 2179416 A (hereinafter referred to as "Edge"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The newly amended independent Claim 48 recites, *inter alias*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with

an inner surface retaining the cap on the body through an interference fit with the notch. Edge fails to disclose or suggest a retaining surface and a notch positioned on the retaining surface and located at one end of the body. Further, Edge fails to disclose or suggest the cap with an inner surface retaining the cap on the body through an interference fit with the notch.

The Examiner alleges Edge teaches "the cap is held onto the body via an interference fit facilitated by at least one groove." Contrary to the Examiner's assertion, Applicants submit that Edge teaches the cap held onto the body by "staking." See Edge, Col. 2, ll. 69-72. One skilled in art would recognize that staking the cap is not identical or equivalent to the cap held onto the body via an interference fit. For at least these reasons, Edge does not anticipate these claims.

FR 633186 A

The Examiner alleges Claims 48, 49, 50, 52, 53, 54, 56, 60 and 61 are anticipated by FR 633186 A (hereinafter referred to as "Valery"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The newly amended Claim 48 now recites, *inter alias*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with an inner surface retaining the cap on the body through an interference fit with the notch. Valery fails to teach a retaining surface and a notch positioned on the retaining surface and located at one end. Further, Valery fails to disclose or suggest the cap with an inner surface retaining the cap with an interference fit with the notch.

The Examiner alleges Valery teaches "the cap held onto the body via an interference fit facilitated by at least one groove. (unlabeled annular indentation)." Contrary to the Examiner's assertion, Applicants submit that Edge teaches the cap held onto the body by "crimping." See Valery translation, Pg. 1, ll. 7-8. One skilled in art would recognize that crimping the cap is not identical or equivalent to the cap held onto the body via an interference fit. For at least these reasons, Valery does not anticipate these claims.

Claim 60 recites, *inter alias*, a torque transmitter that includes a groove that, at least in part, retains a cap on the body and the cap is shaped according to the grooved body so that when the body is torqued and interference fit is achieved between the cap and the body. Valery fails to disclose or suggest a torque transmitter that includes a groove that, at least in part, retains a cap on the body and the cap is shaped according to the grooved body so that when the body is torqued and interference fit is achieved between the cap and the body.

U.S. Patent No. 4,143,578 to Becker

The Examiner alleges Claims 48, 49, 50 52, 54, 55 and 56 are anticipated by U.S. Patent No. 4,143,578 to Becker (hereinafter referred to as "Becker"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The amended Claim 48 now recites, *inter alias*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with an inner surface retaining the cap on the body through an interference fit with the notch. Becker fails to disclose or suggest a retaining surface and a notch positioned on the retaining surface and located at one end of the body. Further, Becker fails to disclose or suggest a cap with an inner surface retaining the cap on the body through an interference fit with the notch.

The Examiner alleges "the cap is held onto the body via an interference fit facilitated by at least one groove." The Examiner is correct to point out that Becker teaches a groove; however, the groove in Becker is a sharp essentially right angled shoulder which is required to crimp the cap to the body. See Becker, Col. 2, ll. 54-62. As previously stated above, one skilled in art would recognize that crimping the cap is not identical or equivalent to the cap held onto the body via an interference fit. For at least these reasons, Becker does not anticipate these claims.

U.S. Patent No. 4,557,654 to Masuda et al.

The Examiner alleges Claims 48, 49, 50 52, 54, 55 and 56 are anticipated by U.S. Patent No. 4,557,654 to Masuda et al (hereinafter referred to as "Masuda"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The amended Claim 48 now recites, *inter alia*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with an inner surface retaining the cap on the body through an interference fit with the notch. Masuda fails to disclose or suggest a retaining surface and a notch positioned on the retaining surface and located at one end of the body. Further, Masuda fails to disclose or suggest a cap with an inner surface retaining the cap on the body through an interference fit with the notch.

The Examiner alleges Masuda teaches "the cap is held onto the body via an interference fit facilitated by at least one groove comprising a plurality of notches. Contrary to the Examiner's assertion, Masuda teaches the cap secured by "extrusions 26 to be engaged with said recesses 22 so that they operate as turning-proof means of the cover 24, when the cover 24 is applied after being engaged with the bolt 23. Masuda, Col. 5, ll. 31-35. One skilled in art would recognize that holding the cap by extrusions is not identical or equivalent to the cap held onto the body via an interference fit. For at least these reasons, Masuda does not anticipate these claims.

U.S. Patent No. 4,427,326 to Hobson et al.

The Examiner alleges Claims 48, 49, 50, 52, 54, 55 and 56 are anticipated by U.S. Patent No. 4,427,326 to Hobson *et al.* (hereinafter referred to as "Hobson"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The amended Claim 48 now recites, *inter alia*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with an inner surface retaining the cap on the body through an interference fit with the notch. Hobson fails to disclose or suggest a retaining surface and a notch positioned on the retaining surface and located at one end of the body. Further, Hobson fails to disclose or suggest a cap with an inner surface retaining the cap on the body through an interference fit with the notch.

The Examiner alleges Hobson teaches "the cap is held onto the body via an interference fit facilitated by at least one groove." Contrary to the Examiner's assertion,

Applicants respectfully submit that Hobson teaches a frangible neck 32 fabricated to fracture at a readily achievable torque separating portion 20 and portion 30; a snap-ring 40 is disclosed to lock portion 20 and portion 30 together. See Hobson, Col. 3, ll. 41-54. One skilled in art would recognize securing two portions by way of a snap ring is not the same as the cap held onto the body via an interference fit. For at least these reasons, Hobson does not anticipate these claims.

U.S. Patent No. 3,960,047 to Liffick

The Examiner alleges Claims 48, 49, 50, 52, 54, 55 and 56 are anticipated by U.S. Patent No. 3,960,047 to Liffick (hereinafter referred to as "Liffick"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The amended Claim 48 now recites, *inter alia*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with an inner surface retaining the cap on the body through an interference fit with the notch. Liffick fails to disclose or suggest a retaining surface and a notch positioned on the retaining surface and located at one end of the body. Further, Liffick fails to disclose or suggest a cap with an inner surface retaining the cap on the body through an interference fit with the notch.

U.S. Patent No. 5,350,266 to Espey et al.

The Examiner alleges Claims 48, 49, 50, 52, 56 and 57 are anticipated by U.S. Patent No. 5,350,266 to Espey et al (hereinafter referred to as "Espey"). Applicants respectfully disagree and request the Examiner's rejection be withdrawn.

The amended Claim 48 now recites, *inter alia*, a retaining surface and a notch positioned on the retaining surface and located at one end of the body and a cap with an inner surface retaining the cap on the body through an interference fit with the notch. Espey fails to disclose or suggest a retaining surface and a notch positioned on the retaining surface and located at one end of the body. Further, Espey fails to disclose or suggest a cap with an inner surface retaining the cap on the body through an interference fit with the notch.

The Examiner alleges that Espey teaches "the cap is held onto the body via an interference fit facilitated by at least one groove comprising a plurality of notches.. Contrary to the Examiner's assertion, Espey teaches the use of side walls with radial projections 53 and ramps 53 in order to secure the cap with an inner end face that is parallel to the central transverse plane of the cap 40. See Espey, Col. 3, ll. 17-24. One skilled in art would recognize that retaining the cap with radial projections having ramps is not identical or equivalent to the cap held onto the body via an interference fit. For at least these reasons, Hobson does not anticipate these claims.

For at least these reasons, Applicants respectfully submit that the Examiner's references do not anticipate the present invention. Applicants respectfully request that the Examiner's 35 U.S.C. § 102 rejections be withdrawn.

G. Claim Rejections: 35 U.S.C. § 103

Claims 58-63 stand rejected under 35 U.S.C. § 103(a). The Examiner alleges that Claims 58-63 are obvious under 35 U.S.C. § 103(a) in view of Becker to any one of: U.S. Patent No. 4,240,670 to Zorn *et al.* (hereinafter referred to as "Zorn"); or, U.S. Patent No. 1,940,675 to Crowther (hereinafter referred to as "Crowther"); or, Edge. Applicants respectfully disagree and request that the Examiner's rejection be withdrawn.

Applicants submit that the Examiner has not established a *prima facie* obviousness case. The Examiner simply pieced together references to combine and formulate the present invention. References must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention. See M.P.E.P. § 2141 (citing *Hodosh v. Block Drug Co., Inc.*, 786 F.2d 1136, 1143 n.5, 229 USPQ 182, 187 n.5 (Fed. Cir. 1986)). Here the Examiner's rejection amounts to mere "hindsight" by the Examiner. Accordingly, the Examiner has not established a *prima facie* obviousness case.

The references must provide teaching, suggestion or motivation to combine

"The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. M.P.E.P. § 2143.01 (Citing *In re mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed.

Cir. 1990)). If the "proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." M.P.E.P. § 2143.01. Similarly, "If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teaching of the references are not sufficient to render the claims prima facie obvious." M.P.E.P. § 2143.01. When evaluating whether one or more prior art references suggests or teaches all the claim limitations, each prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. M.P.E.P. § 2141.02.

There must be a reasonable expectation of success and all limitations must be taught

There must be a reasonable expectation of success to modify or combine the prior art to reject claims as prima facie obvious. See M.P.E.P. § 2143.02 (citing *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)). To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. M.P.E.P. § 2143.03 (citing *In re Rayka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)).

The references must not teach away from each other

A prior art reference may be considered to teach away when 'a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.' *In re Gurley*, 27 F.3d 551, 31 USPQ2d 1130 (Fed. Cir. 1994). That the inventor achieved the claimed invention by doing what those skilled in the art suggested should not be done is a fact strongly probative of non-obviousness. *Kloster Speedsteel AB v. Crucible Inc.*, 793 F.2d 1565, 230 USPQ 81 (Fed. Cir. 1986) on rehearing, 231 USPQ 160 (Fed. Cir. 1986).

Becker in view of Zorn

The Examiner alleges Claims 58-63 are unpatentable over the proposed combination of Becker and Zorn. Applicants respectfully point out that there is no teaching suggestion or motivation to combine these references. Further, the Examiner's proposed combination of Becker and Zorn teach away from each other. The entire point of the nut in Becker is to secure wheels *without* wheel covers. According to Becker "covers are expensive, add weight

to the car and often become lost due to failure, under the extreme stresses imposed by high speed and rapid maneuvering of the vehicle, of the means employed to attach the covers to the wheels." Becker, Col. 1, ll. 24-28. Though the purpose of Becker is to eliminate the use of a wheel cover, the purpose of the lug nut in Zorn is to secure a wheel cover to a wheel for decorative purposes, as well as, to protect the wheel hub from accumulation of particles, debris, dirt and dust. See Zorn, Col. 1, ll. 16-19. Accordingly, Becker teaches away from the use of a wheel cover, whereas, the lug nut in Zorn is designed to retain a wheel cover. Therefore, Becker and Zorn teach away from each other because the claimed invention does what those skilled in the art suggest not to be done. For at least this reason, the obviousness rejection must fail.

Further, the Examiner's proposed combination of Becker and Zorn would change the principle of operation of each reference. Becker discloses "a groove configured to form a substantially right angled shoulder axially terminating the polygonal side walls." Becker, Col. 2, ll. 50-53. On the other hand, Zorn discloses a tapered 48 lug nut 16 used to secure a wheel cover 22 by way of two different apertures (24 and 26). See Zorn, Col. 3, ll. 45-55. Because the purpose of the wheel cover in Zorn is to cover an unfinished wheel and protect the wheel hub, the wheel cover covers as much area as possible. Aperture 26 can not be so large in diameter that it defeats this purpose. Conversely, aperture 24 must be sized to allow the lug nut to seat against the wheel, while still providing a sufficient area for the lug nut to retain the wheel cover. Accordingly, Zorn requires proper dimensions to be maintained between apertures 24 and 26. See Zorn, Col. 4, ll. 33-35. The lug nut in Zorn must have a maximum diameter, disclosed as point 49, which enables the lug nut to pass through aperture 26 and yet seat against aperture 24. The combination of Becker and Zorn would not allow the lug nut to pass through aperture 26 and yet seat against aperture 24 because the groove in Becker would prevent the lug nut from passing through aperture 26. Consequently, the Examiner's combination would change the principle of operation of the respective references, and therefore, the teachings of the references are not sufficient to render the Claims *prima facie* obviousness. For at least this reason, the obviousness rejection must fail.

Further, The Examiner's proposed combination of Becker and Zorn would change a second principle of operation of each. The purpose of the groove in Becker is to provide a substantially flat surface for the cap to be crimped. See Becker, Col.2, ll. 59-63. On the other hand, Zorn discloses a tapered 48 lug nut 16 with a maximum diameter at point 49 and a resilient washer 52. See Zorn, Col. 2, ll. 3-5. According to Zorn, when the lug nut is torqued the resilient washer expands radially. See Zorn, Col. 2, ll. 21-26. The resilient washer secures the wheel cover against the vehicle wheel without an interference fit. See Zorn, Col. 2, ll. 21-26. The flat surface in Becker would not cause the resilient washer to expand radially. Therefore, the groove in Becker would prevent the seating of the wheel cover without an interference fit. Consequently, the Examiner's combination would change the principle of operation of the respective references, and therefore, the teachings of the references are not sufficient to render the Claims *prima facie* obviousness. For at least these reasons, Applicants respectfully request the Examiner withdraw the rejection.

Becker in view of Crowther

The Examiner alleges Claims 58-63 are unpatentable over the combination of Becker and Crowther. Applicants submit that there is no teaching suggestion or motivation to combine these references. Further, the Examiner's proposed combination of Becker and Crowther would change the principle of operation of the respective references. Becker discloses "a groove configured to form a substantially right angled shoulder axially terminating the polygonal side walls." Becker, Col. 2, ll. 50-53. Becker further discloses the lip of the cup shape cap is crimped over the groove forming triangular configurations 42. See Becker, Col. 2, ll. 59-63. The triangular configurations do not form a flat surface. See Becker, Col. 4, ll. 53-65. On the other hand, Crowther discloses a helical resilient washer 8 with a radial face 9 in contact with the flat radial face 10 of the nut body. See Crowther, Col. 2, ll. 29-33. One object of Crowther is to "provide a positive lock between the constrained surfaces and the constraining surface in such a manner that the relationship between the surfaces will not be destroyed by shock or vibration." Crowther, Col. 1, ll. 44-49. The Examiner's proposed combination of Becker and Crowther would not allow the required relationship between the constrained surface and the constraining surface because the "crimped lip" and "triangular configurations" in Becker would not provide the necessary flat radial face 10 as required in Crowther. Accordingly, the relationship between the

constrained surface and the constraining surface would be destroyed by shock or vibration. Consequently, there is no motivation or suggestion to make the proposed combination. For at least this reason, the obviousness rejection must fail.

Further, the Examiner's proposed combination of Becker and Crowther would not arrive at all of the claim limitations of Claims 58-63. As admitted by the Examiner, Becker fails to disclose the annular bearing surface generally spherically convex in shape. Instead, Becker discloses a bearing surface that is generally frustum in shape. The defect in Becker cannot be cured by Crowther because Crowther does not disclose an annular bearing surface that is spherically generally convex. One skilled in the art recognizes that the bearing surface in Crowther is a frustum shaped bearing surface. Frustum is shaped as "the part that is left when a cone or pyramid is cut by a plane parallel to the base and the apical part is removed." (<http://dictionary.reference.com/browse/frustum>). An annular bearing surface that is spherically convex in shape has a different meaning, namely, "curving out or bulging outward." (http://en.wikipedia.org/wiki/Conical_surface). Assuming arguendo, that Becker is combined with Crowther, the combination would not include an annular bearing surface that is spherically convex. For at least this reason, the Examiner's combination does not disclose or suggest all claim limitations. Accordingly, the obviousness rejection must fail.

Further, the Examiner's proposed combination of Becker and Crowther teach away from each other. The groove in Becker enables the cap to be crimped to the body by way of a lip which forms triangular configurations. See Becker, Col. 2, ll. 59-63. According to Becker, the triangular configurations are depressed below the level the adjacent lateral sides. See Becker, Col. 4, ll. 50-65. Although the purpose of Becker is to crimp the cap, thereby forming a surface that is not flat, the purpose in Crowther is to provide a flat radial face 10. According to Crowther, the flat radial face 10 is in contact with the radial face 9 of the helicoidal resilient washer 8. See Crowther, Col. 2, ll. 29-33. The triangular configurations in Becker are designed to prevent rotation, whereas, in any nut and washer application, the nut must rotate against the washer. Therefore, Becker and Crowther teach away from each other because the claimed invention does what those skilled in the art suggest not to be done. For at least these reasons, Applicants respectfully request the Examiner withdraw the rejections.

Becker in view of Edge

The Examiner alleges Edge teaches a generally spherically convex annular bearing surface (16). Applicants do not understand the basis for the Examiner's rejection because (16) is not shown in the figures or the specification of Edge.

Further, the Examiner's proposed combination of Becker and Edge would change the principle of operation of the respective references. Becker discloses "a groove configured to form a substantially right angled shoulder axially terminating the polygonal side walls." Becker, Col. 2, ll. 50-53. Becker further discloses the lip of the cup shape cap is crimped over the groove forming triangular configurations 42. See Becker, Col. 2, ll. 59-63. The triangular configurations do not form a flat surface. See Becker, Col. 4, ll. 53-65. On the other hand, Edge discloses a washer 3 in operation with a steel nut 2 having a cap that hides the washer 3 from view without interfering with the operation of the washer 3. See Edge, Col. 2, ll. 100-105. Accordingly, an object in Edge is to provide a cap which hides the washer and does not interfere with the operation of the washer. The Examiner's proposed combination of Becker and Edge would interfere with the operation of the washer because the "crimped lip" and "triangle configurations" in Becker would not provide the necessary flat radial surface required and would interfere with the operation of the washer. Further, the crimped cap in Becker would not hide the washer 3. Consequently, the Examiner's combination would change the principle of operation of the respective references, and therefore, the teachings of the references are not sufficient to render the Claims *prima facie* obviousness. For at least this reason, the obviousness rejection must fail.

Additionally, Edge is similar to Crowther, in that, Edge discloses a frustum shaped bearing surface and not a bearing surface spherically convex in shape. As such, Edge cannot cure the defects with Becker and the Examiner's proposed combination fails to arrive at the present invention. Assuming *arguendo*, that Becker is combined with Edge, the combination would not include an annular bearing surface that is spherically convex in shape or a groove including a curved surface. Accordingly, for at least this reason, the Examiner's combination does not disclose or suggest all claim limitations. For at least this reason, the obviousness rejection must fail.

Further, the Examiner's proposed combination of Becker and Edge teach away from each other. The groove in Becker enables the cap to be crimped to the body by way of a lip which forms triangular configurations. See Becker, Col. 2, ll. 59-63. According to Becker, the triangular configurations are depressed below the level the adjacent lateral sides. See Becker, Col. 4, ll. 50-65. Although the purpose of Becker is to crimp the cap, thereby forming a surface that is not flat, the purpose in Edge is to have a cap that does not interfere with the operation of the washer 3. According to Edge, washer 3 is in contact with the radial face of the steel nut 2. See Fig. 1. The triangular configurations in Becker are designed to prevent rotation, whereas, in any nut and washer application, the nut must rotate against the washer. Therefore, Becker and Edge teach away from each other because the claimed invention does what those skilled in the art suggest not to be done. For at least these reasons, Applicants respectfully request the Examiner withdraw the rejection.

For at least these reasons, Applicants respectfully submit that the claimed invention is non-obvious and request that the 35 U.S.C. § 103(a) rejection be withdrawn.

02/28/2007 WED 15:15 FAX 1 847 970 4600 MacLean-Fogg Legal Dept.

029/030

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Conclusion

In view of the foregoing, Applicants respectfully request reconsideration, withdrawal of rejections, and allowance of all Claims now present in the application.

The Commissioner is authorized to charge any required fees, including any extension and/or excess claim fees, any additional fees, or credit any overpayment to Deposit Account No. 502318.

Dated: February 28, 2007

Respectfully Submitted,

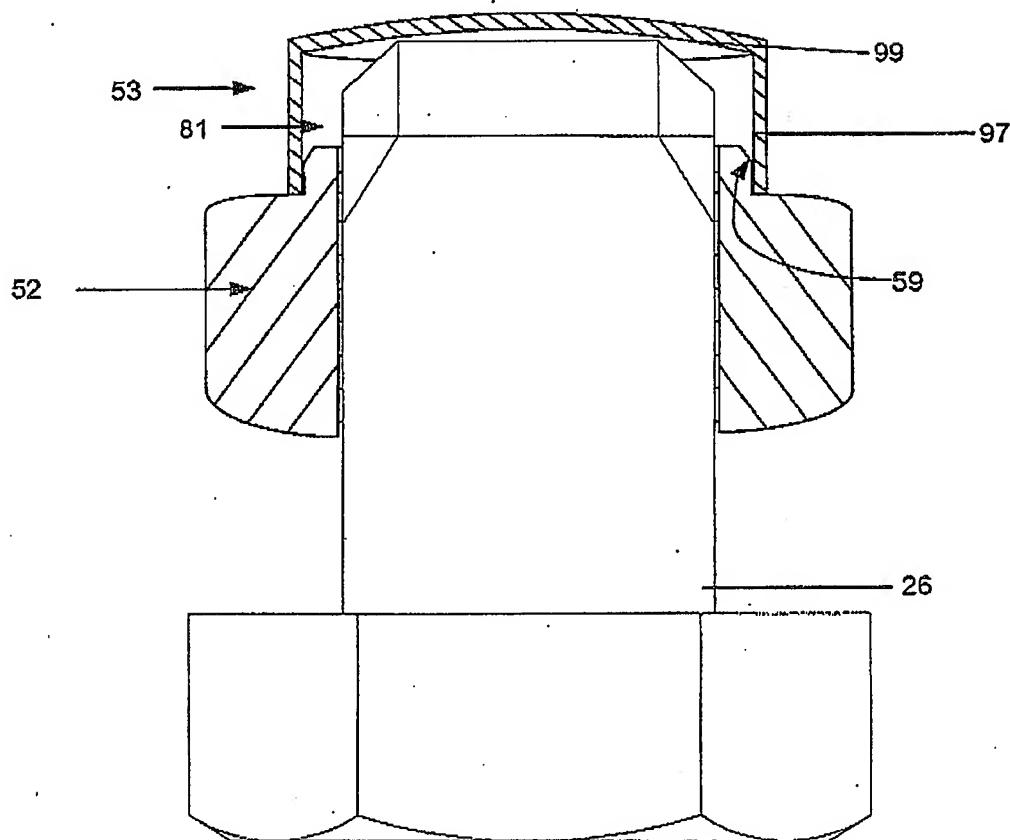


Dana Andrew Alden
(Reg. No. 46,475)

The Alden Law Group, L.L.P.
2122 York Road, Suite 180
Oak Brook, Illinois 60523
P: (630) 368-7676
F: (630) 368-7677

Replacement Sheet

FIG.30



23

08-31-2006 OFFICE ACTION



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,611	11/13/2003	Theodore Bydalek	11-9540-6520-0000-2	9015
7590	08/31/2006		EXAMINER	
Dana Andrew Alden MacLean-Fogg Company 1000 Allanson Road Mundelein, IL 60060			SHARP, JEFFREY ANDREW	
			ART UNIT	PAPER NUMBER
			3677	

DATE MAILED: 08/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/712,611	BYDALEK ET AL.	
	Examiner Jeffrey Sharp	Art Unit 3677	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 14 June 2006.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 48-66 is/are pending in the application.
- 4a) Of the above claim(s) 64-66 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 48-63 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 17 November 2005 and 13 November 2003 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All
 - b) Some *
 - c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)
3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____	6) <input type="checkbox"/> Other: _____

DETAILED ACTION

[1] This action is responsive to Applicant's request for consideration filed on 14 June 2006 with regard to the final Official Office action mailed on 14 February 2006.

Status of Claims

[2] Claims 1-47 are cancelled and therefore, all previous rejections and arguments are moot in view of the new grounds of rejection presented in this Office Action. New apparatus claims 48-63 are pending.

Newly submitted claims 64-66 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The claims recite a method, which differs from the apparatus invention previously examined.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, new claims 64-66 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Information Disclosure Statement

[3] Applicant's lengthy IDS filed 6/19/2006 has not yet been fully considered. All foreign and NPL documents have been considered. A brief review of the documents contained therein revealed that most of the documents are unrelated to the claims of this application. Therefore, the applicant is requested to identify twenty or so documents most relevant to the claims of this

application, so that they may be given proper consideration by the examiner. Though now simply a request, it may be applied under Rule 105 in the future.

Double Patenting

[4] Claims 62 and 63 are objected to under 37 CFR 1.75 as being a substantial duplicate of claims 58 and 59. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Drawings

[5] The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "annular bearing surface on the body is spherically convex" must be shown or the feature(s) canceled from the claim(s). No new matter should be entered. Support for this limitation is found in originally filed paragraph [0061]; however, the originally filed drawings fail to show this embodiment. The originally filed drawings only show a frustoconical annular bearing surface.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure

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must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

New Grounds of Rejection

Claim Rejections - 35 USC § 112

[6] The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

[7] Claim 60 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Element "e)" is missing.

Claim Rejections - 35 USC § 102

[8] The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

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(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

[9] Claims 48, 49, 50, 52, 54, 55, and 56 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by GB 2179416 A.

In short, GB 2179416 A teaches a fastener assembly (figure 1) comprising a body (5) being configured as a nut and having a torque transmitter (clearly shown in figure 2) and threads, and a cap (4) retained on the body (5), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (@ 9 and 10). The body (5) has an annular bearing surface (extreme right) adjacent a generally cylindrical surface (2). The fastener assembly further includes a washer (3).

[10] Claims 48, 49, 50, 52, 53, 54, 56, 60 (as understood), and 61 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by FR 633186 A.

In short, FR 633186 A teaches a fastener assembly comprising a body (a) being configured as a nut and having a torque transmitter (b) and threads, and a cap (d) retained on the body (a), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (unlabeled annular indentation). The body (a) has an annular bearing surface (left figure 1) adjacent a generally cylindrical surface.

[11] Claims 48, 49, 50, 52, 54, and 56 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Becker US-4,143,578.

In short, Becker teaches a fastener assembly (10) comprising a body (12) being configured as a nut and having a torque transmitter (hexagonal profile) and threads (24), and a cap (14) retained on the body (12), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (26). The body (12) has an annular bearing surface (18) adjacent a generally cylindrical surface (30).

[12] Claims 48, 49, 50, 51, 52, 54, and 56, are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Masuda et al. US-4,557,654 (figures 7 and 8).

In short, Masuda et al. teaches a fastener assembly comprising a body (figure 7) being configured as a nut and having a torque transmitter (profile) and threads, and a cap (24) retained on the body (figure 7), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (22) comprising a plurality of notches (22). The body (figure 7) has an annular bearing surface (not labeled, above 27). The fastener assembly further includes a washer (27).

[13] Claims 48, 49, 50, 52, 54, 55, and 56 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Hobson et al. US-4,427,326.

In short, Hobson et al. teaches a fastener assembly (figure 2) comprising a body (20) being configured as a nut and having a torque transmitter (50) and threads, and a cap (30) retained on the body (20), wherein the cap is held onto the body via an interference fit facilitated

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by at least one groove (24). The body (20) has an annular bearing surface (26) adjacent a generally cylindrical surface (25). The fastener assembly further includes a washer (40).

[14] Claims 48, 49, 50, 52, 54, 55, and 56 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Liffick US-3,960,047.

In short, Liffick teaches a fastener assembly comprising a body (20) being configured as a nut and having a torque transmitter (hexagonal profile 22) and threads (34), and a cap (42) retained on the body (20), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (48). The body (20) has an annular bearing surface (30) adjacent a generally cylindrical surface (@ 48).

[15] Claims 48, 49, 51, 52, 56, and 57 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Espey et al. US-5,350,266.

In short, Espey et al. teaches a fastener assembly comprising a body (20) being configured as a nut and having a torque transmitter (hexagonal profile) and threads, and a cap (40) retained on the body (20), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (33) comprising a plurality of notches (33). The body (20) has an annular bearing surface (28).

Claim Rejections - 35 USC § 103

[16] The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

[17] Claims 58-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Becker US-4,143,578 in view of any one of Crowther US-1,940,675 or Zorn et al. US-4,240,670 or GB 2051285 A.

In short, Becker teaches a fastener assembly (10) comprising a body (12) being configured as a nut and having a torque transmitter (hexagonal profile) and threads (24), and a cap (14) retained on the body (12), wherein the cap is held onto the body via an interference fit facilitated by at least one groove (26). The body (12) has an annular bearing surface (18) adjacent a generally cylindrical surface (30).

However, Becker fails to disclose expressly, the annular bearing surface (18) to be generally spherically convex.

Crowther suggests on page 2 lines 116-119, that an annular bearing surface for a nut is an obvious variant of a conical bearing surface in the art.

Zorn et al. suggest on column 3 lines 48-49, a generally spherically convex annular bearing surface (48). The generally spherical convex shape of the annular bearing surface causes the surrounding washer (52) to expand radially outwardly after torque is applied to the nut, and to facilitate frictional engagement between the washer and its mating workpiece (12').

GB 2051285 A suggests a generally spherically convex annular bearing surface (16) for self-centering purposes.

Therefore, at the time of invention, it would have been obvious to one of ordinary skill in the art to modify the annular bearing surface (18) taught by Becker, to be generally spherically convex as suggested by Zorn et al., in order to cause radially outward expansion of a surrounding washer. It would have also been obvious to one of ordinary skill in the art to substitute the annular bearing surface (18) taught by Becker, for a generally spherically convex annular bearing surface, since Crowther deems the two to be art-recognized equivalents. Lastly, it would have been obvious to one of ordinary skill in the art to modify the annular bearing surface (18) taught by Becker, to be generally spherically convex as suggested by GB 2051285 A, in order to improve the self-centering function of the fastener assembly, especially when in engagement with a washer.

Conclusion

[18] The prior art made of record and not relied upon is considered pertinent to applicant's disclosure is as follows: See form PTO-892.

[19] Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeffrey Sharp whose telephone number is (571) 272-7074. The examiner can normally be reached 7:00 am - 5:30 pm Mon-Thurs.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, J.J. Swann can be reached on (571) 272-7075. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

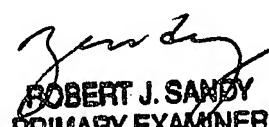
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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JAS



8/8/06



ROBERT J. SANDY
PRIMARY EXAMINER

11-13-2003 SPECIFICATION

Express Mail mailing label number: EV 269382755 US

Date of Deposit: November 13, 2003

Our Case No.: 11-9540-6520-0000-2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTORS: David A. Harris
Theodore J. Bydalek
Larry J. Wilson

TITLE: Fastener Assembly

ATTORNEY: Dana Andrew Alden
Registration No. 46,475
MacLean-Fogg Company
1000 Allanson Road
Mundelein, IL 60060

FASTENER ASSEMBLY

This is a continuation-in-part of application number 09/933,312, filed on August 20, 2001, the disclosure of which is hereby incorporated by reference.

5 FIELD OF THE INVENTION

This invention relates to fastener assemblies, and particularly to fastener assemblies provided with a cap.

BACKGROUND OF THE INVENTION

10 Fasteners are known in the art and are used for threading onto a threaded member. The present invention is an improved fastener that is provided with a cap.

SUMMARY OF THE INVENTION

15 The scope of the present invention is defined solely by the appended claims, and is not affected to any degree by the statements within this summary. Briefly stated, a fastener assembly, comprising a nut configured to retain a cap, a washer having a bearing surface, the nut and the washer being rotatable relative to each other about a common axis, the nut having an annular surface axially
20 opposed to the bearing surface, and the annular surface and the bearing surface are undulating in shape.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is an end view of a vehicle axle and wheel hub having a fastener
25 assembly of the preferred embodiment threaded onto a stud and a fastener assembly of an alternative embodiment threaded onto a spindle;
FIGURE 2 is a sectional view taken along line 2-2 of FIGURE 1;
FIGURE 3 is an exploded perspective view a washer of an alternative embodiment;
30 FIGURE 4 is a bottom plain view, partially in section, of a fastener assembly of an alternative embodiment;

FIGURE 5 is a top plain view, partially in section, of a fastener assembly of an alternative embodiment;

FIGURE 6 is a side elevational view, partially in section, of a nut and washer of an alternative embodiment;

5 FIGURE 7 is a plain view of a quarter segment of overlying annular and bearing surfaces of a nut and washer, respectively, of an alternative embodiment, showing their relationship to each other circumferentially;

FIGURE 8 is an enlarged sectional view of an arcuate portion (on an 180 arc in the present illustration) of the faces and faces mating in the assembly of an

10 alternative embodiment, the view depicting curved surfaces as straight because of this;

FIGURE 9 is a side elevational view of a nut of an alternative embodiment, showing the convex curvature of its inclined faces;

FIGURE 10 is a side sectional view through the washer of an alternative

15 embodiment, showing the concave curvature of its inclined faces;

FIGURE 11 is a side elevational view of a nut of the preferred embodiment;

FIGURE 12 is a side elevational view of a nut of the preferred embodiment;

FIGURE 13 is a side elevational view, in section, of a washer of the preferred embodiment;

20 FIGURE 14 is an exploded perspective view of a fastener assembly of the preferred embodiment;

FIGURE 15 is a bottom plain view, partially in section, of a fastener assembly of the preferred embodiment;

FIGURE 16 is a top plain view, partially in section, of a fastener assembly of the

25 preferred embodiment;

FIGURE 17 is a bottom plain view of a cap of the preferred embodiment;

FIGURE 18 is a side elevational view of a cap of the preferred embodiment;

FIGURE 19 is side elevational view of a fastener assembly of the preferred embodiment;

30 FIGURE 20 is a side elevational view, in section, of a fastener assembly of the preferred embodiment;

FIGURE 21 is a close-up view of a frictional surface on the nut of the preferred embodiment;

FIGURE 22 is a close up view of a frictional surface on the cap of an alternative embodiment;

5 FIGURE 23 is a close up side elevational view of an annular surface on a nut of an alternative embodiment;

FIGURE 24 is a side elevational view, in section, of a bearing surface on a washer of an alternative embodiment;

10 FIGURE 25 is a side elevational view, in section, of a washer of an alternative embodiment;

FIGURE 26 is a close up side elevational view, in section, of a clamping surface on a washer of an alternative embodiment;

FIGURE 27 is a side elevational view, in section, of a washer of an alternative embodiment;

15 FIGURE 28 is a side elevational view, in section, of a cap and a nut of the preferred embodiment in relation to a socket from a socket wrench;

FIGURE 29 is a side elevational view, in section, of a cap and a nut of the preferred embodiment;

20 FIGURE 30 is a side elevational view, in section, of a cap and a nut of the preferred embodiment in relation to a stud;

FIGURE 31 is a side elevational view, in section, of a bearing surface on a washer of an alternative embodiment;

FIGURE 32 is a side elevational view, in section, of a washer of an alternative embodiment;

25 FIGURE 33 is a close up side elevational view of the annular surface on the nut of an alternative embodiment;

FIGURE 34 is a side elevational view, in section, of the fastener assembly of an alternative embodiment in relation to a stud having a notch;

30 FIGURE 35 is a side elevational view, in section, of the fastener assembly an alternative embodiment;

FIGURE 36 is an exploded perspective view of a fastener assembly of an alternative embodiment;

FIGURE 37 is an exploded perspective view of a partially finished nut of the presently preferred embodiment; and

5 FIGURE 38 is a bottom plain view, partially in section, of a fastener assembly of an alternative embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGURES 1 and 2, an axle assembly for an automotive vehicle is shown generally at 10. The axle assembly 10 includes a stud 26, in the form of spindle 12, which extends horizontally from a vertically oriented plate 14. The plate 14 forms the outer face of a fitting 16 which is mounted in a conventional manner on the frame (not shown) of a vehicle.

Seated for rotation on the spindle 12 is a wheel hub 20. The wheel hub 20 includes a generally cylindrical body 22. The wheel hub 20 is seated on the spindle 12 on an inner roller bearing assembly 28 and an outer roller bearing assembly 29. The inner bearing assembly 28 is located on a cylindrical inner section 31 of the spindle 12 and is retained between a shoulder 33 on the spindle and an opposing shoulder 35 inside the body 22 of the wheel hub 20. The outer bearing assembly 29 is located on a cylindrical outer section 37 of the spindle 12 and is seated against a shoulder 39 inside the hub body 22 and against a frusto-conical spacer 41 encircling the tapered mid-section 43 of the spindle on the inner end of the bearing assembly.

The cylindrical body 22 is formed unitarily with a radially extending flange 24. A plurality of studs 26 extend axially from the flange 24 near its periphery. The studs 26 are employed in a conventional manner to mount a wheel (not shown) on the wheel hub 20. As depicted in FIGURES 1 and 2 the fastener assembly 50 of a presently preferred embodiment is threaded onto stud 26.

Referring now to FIGURE 19, the presently preferred embodiment of the fastener assembly 50 is depicted. As depicted therein, the fastener assembly 50

is provided with a nut 52. The nut 52 includes a metal, preferably a carbon steel, such as 1020 to 1045 steel.

The nut body 62 shown in FIGURE 19 is forged. The steel is first heated to 2100° F, cut into segments, and pressed so that it is circular and larger in diameter. Then a portion of the inner surface 63 and a torque transmitting surface 66 are forged. Thereafter, a portion of the inner surface 63 is punched out and the nut 52 is then heat treated to an average hardness ranging between 26 and 36 on the Rockwell C scale, preferably 31.

The washer body 82 of the preferred embodiment, depicted in FIG. 14, is fabricated from an alloy grade steel, such as 4140 steel. In an alternative embodiment, a medium carbon steel such as 1020 to 1045 steel is used. It is preferred that the washer body 82 is fabricated through forging. The steel is first heated to 2100° F, cut into segments, and pressed so that it is circular and larger in diameter. Then, an annulus is formed and punched out. The washer body 82 is heat treated to an average hardness ranging between 28 and 42 on the Rockwell C scale, preferably 36.

The nut 52 and washer 54 are assembled together. The nut 52 is mated with the washer 54 and then a skirt 68 on the nut is flared out to form a collar 85. The collar 85 advantageously provides a lead for the threads 64. Then, a tap is sent down through the nut body 62, and threads 64 are cut into the nut body 62. The threads 64 have a diameter preferably in the range of approximately .3125 inches, up to approximately 1.25 inches.

After the threads 64 have been cut, the nut body 62 is put through a machining center. The minor diameter of the threads 64 within the nut body 62 is chucked and then turned or grooved. The nut 52 is placed on a collet or mandrel and turned or grooved. The collet grips the minor diameter sufficiently to prevent slipping and the nut body 62 is spun around. A grooving tool is plunged into the side of the nut body 62 and shaves off material so that the previously hexagonal shape is more desirably shaped for a retaining surface 59.

After the nut body 62 is turned or grooved, a frictional surface 70 is fashioned into the retaining surface 59. The frictional surface 70 is fabricated

using a knurling tool. In the preferred embodiment, the knurling tool is configured to impress a "right hand" notch 71 at an angle ranging between 30 to 60 degrees, preferably 45 degrees. In an alternative embodiment, a "left hand" notch 71 at similar angles may be fabricated without departing from the scope of the present

5 invention.

The nut body 62 and/or the washer body 82 may advantageously be provided with a coating. Preferably, the coating is of a formulation that prevents rust and/or corrosion; however, other coatings may be used. By way of example, and not limitation, the coating may be a formulation that reduces friction. In one 10 embodiment, the coating reduces friction between the nut and the washer. In another embodiment, the coating reduces friction within the threads.

Various chemical compounds may be used as suitable coatings. In one embodiment, polytetrafluoroethylene or PTFE is used. In another embodiment, a zinc coating is used. In yet another embodiment, a water-based coating dispersion containing metal oxides and/or aluminum flakes is used.

As shown in FIGURE 11, the nut 52 is provided with a retaining surface 59. The retaining surface 59 cooperates with a cap 53. The retaining surface 59 is configured to retain the cap 53. FIGURE 11 depicts the cap 53 retained on the nut 52 so that an interference fit is achieved between the cap and the retaining 20 surface 59.

The retaining surface 59 of the preferred embodiment is provided with a first surface 60. The first surface 60 is shaped correspondingly to at least a portion of the inner surface 81. As shown in FIGURE 29, the first surface 60 is shaped so that an interference fit can be achieved with the cap 53.

25 Consequently, the first surface 60 can be provided with a plurality of shapes. In the preferred embodiment, the first surface 60 is generally cylindrical.

The retaining surface 59 is provided with a second surface 23. The second surface 23 is shaped so that the cap 53 can be placed on the nut 52 with greater ease. FIGURE 29 depicts the second surface 23 shaped to 30 accommodate the cap 53. As depicted therein, the second surface 23 is generally conical in shape. While the preferred embodiment is shown with a

second surface 23, the retaining surface 59 may be fabricated without a second surface 23.

As shown in FIGURE 12, it is advantageous to provide the retaining surface 59 with a frictional surface 70. Advantageously, the frictional surface 70
5 renders the retaining surface 59 better able to retain the cap 53 through interference fit.

The frictional surface 70 is provided with a higher frictional coefficient. The higher frictional coefficient obtained in the preferred embodiment is achieved by knurling the frictional surface 70. The frictional surface 70 is preferably
10 provided with a plurality of notches 71. As depicted in FIGURE 21, the notches 71 are at an Angle 100 with respect to the axis of the nut depicted as imaginary line A. Angle 100 ranges from 30° to 60°, preferably 45°.

In the preferred embodiment the nut 52 is provided with a nut body 62. As depicted in FIGURE 14, the nut body 62 is provided with threads 64. The
15 internal threads at 64 preferably extend to an internal portion of the retaining surface 59 and an internal portion of a skirt 68.

The nut body 62 is provided with a torque transmitter 66. As shown in FIGURE 14 the torque transmitter 66 is provided on the external surface of the nut body 62. The torque transmitter 66 is shaped to transmit torque, preferably
20 via a plurality of surfaces. As depicted in FIGURE 14, the torque transmitter 66 is hexagonal in shape.

Referring now to FIGURE 11, the nut body 62 is provided with an annular surface 72. The annular surface 72 is located adjacent to the torque transmitter 66. The annular surface 72 is preferably generally frusto-conical in shape. In
25 alternative embodiments, that the annular surface 72 is spherically concave or spherically convex. In yet another alternative embodiment, the annular surface 72 is shaped to cooperate with a surface of the object being fastened; in such an embodiment a washer is unnecessary.

The annular surface 72 is preferably fabricated by cold forging. The cold
30 forging is accomplished through the use of a die insert. The die insert is machined to the desired shape using conventional ball end mill techniques.

In an alternative embodiment the annular surface 72 is configured to cooperate with a bearing surface 84. As shown in FIGURE, 33 the annular surface 72 is undulating in shape. The annular surface 72 is provided with an annularly extending series of surfaces, which provide a uniform undulation around the entire annular surface 72.

FIGURE 23 depicts yet another alternative embodiment of the present invention. As depicted therein, the annular surface 72 is provided with a plurality of lower peaks. The lower peaks are provided as plateaus 74.

The plateaus 74 are generally spherically convex. The plateaus 74 are provided with the same radius as the valleys 122 on the bearing surface 84. The plateaus 74 are formed in the cold forging process so that they are all convex and lie on the surface of an imaginary sphere whose center is on the axis of the nut body 62. The radius of that sphere ranges from 0.1 inches to 2.00 inches.

The plateaus 74 are adjacent to a plurality of faces 73. Each plateau 74 is adjacent to a pair of faces 73 that are oppositely inclined. The annular surface 72 of this alternative embodiment is provided with an annularly extending series of faces 73, which form a uniform undulation around the entire surface. The faces 73 are configured to be complementary to corresponding faces 116 on the bearing surface 84. The faces 73 are provided with the same radius as the faces 73 on the bearing surface 84.

As depicted in FIGURE 23, the faces 73 are preferably generally spherically convex. Each face 73 is formed so that it is convex and is curved both radially and circumferentially with respect to the nut body 62.

Each face 73 is adjacent to a valley 75. Each valley 75 is adjacent to a pair of faces 73. The valleys 75 are configured to be narrower than valleys 122 on the bearing surface 84. As depicted in FIGURE 23, the valleys 75 are generally spherically convex and have a predetermined depth. In one embodiment, the depth is dimensioned according to the number of threads on the nut.

The valley 75 and adjacent faces 73 of the alternative embodiment provide a generally inverted Vee shaped profile. The Vee shaped profile

provides the plateaus 74 with a height. Advantageously, the height is dimensioned according to the distance between the plateau segment 74 and the valley 75. In the embodiment shown herein, the height equals the vertical distance between the plateau 74 and the valley 75. The height is preferably

5 slightly greater than the clearance between the threads at 64 and those on a stud 26, when the fastener assembly 50 is in place. In this alternative embodiment, the height ranges between 0 inches and 0.030 inches

In an alternative embodiment, the height is dimensioned according to the number of threads, measured axially, per inch on the nut. Advantageously the

10 height is related to the number of faces 73 or faces 116. By way of example and not limitation the height, in inches, is proportional to the number of threads per inch and the number of Vee shaped undulations. In the preferred embodiment, the height is proportional to the product of the number of threads per inch and the number of Vee shaped undulations. The height of this alternative embodiment

15 ranges up to approximately .04167 of an inch.

FIGURE 14 depicts the nut body 62 provided with a seating surface 25. As shown in FIGURE 17, the seating surface 25 advantageously corresponds to an intermediate portion 21 of the cap 53. The seating surface 25 is contoured to correspond to the intermediate portion 21. As depicted in FIGURE 14, the

20 seating surface 25 is annular in shape. The seating surface 25 is provided with a higher frictional coefficient to inhibit rotation of the cap 53 with respect to the nut 52.

As shown in FIGURE 14, the nut 52 is provided with a skirt 68. The skirt 68 extends axially away from the nut body 62 at the inner end of internal threads

25 64. The skirt 68 is configured to cooperate with a washer 54. The skirt 68 is shaped to retain a washer 54 in a loose relationship. In the preferred embodiment, the skirt 68 is adapted to extend axially from the annular surface 72 into the generally cylindrical washer body 82 whereupon it is formed outwardly under an undercut shoulder within the washer body 82 to loosely but securely

30 hold the washer 54 and nut 52 together.

Referring now to FIGURE 11, the skirt 68 is unitarily formed and depends from the nut body 62. As shown in FIGURE 20, the skirt 68 is configured to retain the washer. The skirt 68 is configured to underlie a portion of the washer 54, whereby it connects the nut and washer, while permitting the nut 52 and washer to rotate with respect to each other.

In applications that do not require a washer 54, it is desirable for the nut 52 to cooperate with a surface on the object being fastened. Accordingly, in an alternative embodiment, the nut 52 can be fabricated without the skirt 68, without departing from the scope of the present invention.

Referring now to FIG. 19, the fastener assembly 50 is provided with a cap 53. In the preferred embodiment, the cap 53 is composed of an alloy, such as stainless steel; however, in alternative embodiments, the cap 53 may be fabricated from other materials without departing from the scope of the present invention. By way of example and not limitation, the cap 53 may be fabricated from a metal such as aluminum or from a material that includes a polymer.

The cap 53 constituting the presently preferred embodiment is fabricated from a sheet of stainless steel. The preferred method of fabricating the cap 53 is through stamping. However, other methods, such as forming and casting may be employed.

In stamping the cap 53, a round wafer is cut out of the center of the sheet of stainless steel. The wafer is drawn progressively deeper to make it into a cup. Then a final deep drawing elongates the cup into the cap 53.

Referring now to FIGURE 18, the cap 53 is provided with an outer surface 80. It is preferred that the outer surface 80 be provided with a coating. The coating is of a formulation that prevents rust and/or corrosion. Advantageously, the outer surface 80 is decorative. It is preferred that the outer surface 80 be provided with a light reflecting appearance, such as that provided by the use of stainless steel. In an alternative embodiment, the outer surface 80 is provided with a colorful appearance, such as that made possible through the use of plastic as a material.

The outer surface 80 is configured to cooperate with a wrench. As shown in FIGURE 28, the outer surface 80 is shaped to fit within a socket wrench 17. Advantageously, the outer surface is shaped so that the socket wrench 17 applies torque to the torque transmitter 66 rather than the outer surface 80.

5 Referring now to FIGURE 18, the outer surface 80 is provided with a first outer cap surface 87. As shown in FIGURE 29, the first outer cap surface 87 is within the torque transmitter 66. In the preferred embodiment, the first outer cap surface 87 is generally cylindrical in shape.

10 Adjacent to the first outer cap surface 87 is a second outer cap surface 89, as depicted in FIGURE 18. In the preferred embodiment, the second outer cap surface 89 is generally convex.

15 FIGURES 35 and 36 depict an alternative embodiment of the present invention. As shown therein, the inner surface 63 of the nut body 62 is provided with a retaining surface 59. The outer surface 80 of the cap 53 is configured to cooperate with a retaining surface 59.

20 As shown in FIGURES 35 and 36, the outer surface 80 is provided with a first outer cap surface 87. The first outer cap surface 87 is shaped so that an interference fit can be achieved with the retaining surface 59. The cap 53 is placed within the retaining surface 59 so that the notches 71 dig into the first outer cap surface 87.

In this embodiment, the first outer cap surface 87 is shaped according to the retaining surface 59. As depicted in FIG. 35 and 36, the alternative embodiment is provided with a generally cylindrical first outer cap surface 87 that corresponds to the retaining surface 59.

25 In the preferred embodiment, the outer surface 80 of the cap 53 encloses an inner surface 81 that cooperates with the retaining surface 59. In the preferred embodiment, the inner surface 81 is provided with a first inner cap surface 97. The first inner cap surface 97 is configured to cooperate with the retaining surface 59. As shown in FIGURE 29, the first inner cap surface 97 is 30 shaped so that an interference fit can be achieved with the retaining surface 59.

The cap 53 is placed onto the retaining surface 59 so that the notches 71 dig into the first inner cap surface 97.

The inner surface 81 is shaped according to a surface on the nut body 62. As depicted in FIGURE 29, the first inner cap surface 97 is shaped to correspond 5 to the retaining surface 59. In the preferred embodiment, the first inner cap surface 97 is generally cylindrical in shape.

The inner surface 81 is dimensioned to accommodate a stud 26. As depicted in FIGURE 30, the first inner cap surface 97 is provided with a diameter that allows at least a portion of a stud 26 to be located within the inner surface 10 81. The inner surface 81 is provided with a second inner cap surface 99 that is shaped to accommodate the end of the stud 26. In the preferred embodiment, the second inner cap surface 99 is generally concave.

Because a stud, such as the stud 26 depicted in FIG. 1, may vary in length from one stud to another and because a fastener assembly 50 must be properly 15 torqued onto the stud 26 so that a wheel might be safely secured to the wheel hub 20, an unexpectedly long stud 26 might not be accommodated within the inner surface 81 of the cap 53. However, if the inner surface 81 of the cap 53 prevents the complete torquing of the fastener assembly 50, a potentially dangerous condition may arise. To solve this potential problem, the cap 53 is 20 configured to cooperate with the stud 26. The interference fit between the cap 53 and the nut body 62 allows the stud 26 to separate the cap 53 from the nut body 62 so that the fastener assembly 50 may be fully torqued down onto the stud 26.

In an alternative embodiment, the inner surface 81 may be provided with a frictional surface 55. The frictional surface 55 is provided with a higher frictional 25 coefficient. The higher frictional coefficient is achieved by knurling the frictional surface 55.

As shown in FIGURE 17, the frictional surface 55 is located within the first inner cap surface 97. The frictional surface 55 is preferably provided with a plurality of notches 56. Referring now to FIGURE 22, the notches 56 are at an 30 angle 101 with respect to the axis of the nut, depicted as imaginary line A. Angle 101 ranges from 30° to 60°. Angle 101 is preferably 45°.

In an alternative embodiment, the cap 53 is provided with an intermediate portion 21. Preferably, the intermediate portion 21 corresponds to a seating surface 25. The intermediate portion 21 of the alternative embodiment is contoured to correspond to the seating surface 25. As depicted in FIGURE 17,

- 5 the intermediate portion 21 is preferably annular in shape. The intermediate portion 21 of this alternative embodiment is advantageously provided with a higher frictional coefficient to inhibit rotation of the cap 53 with respect to the nut 52.

Referring now to FIGURE 19, the presently preferred embodiment of the fastener assembly 50 is depicted. As depicted therein the fastener assembly 50 is provided with a washer 54, including a washer body 82. The materials of the washer 54 include a metal, preferably an alloy, such as a medium carbon steel. The washer body 82 is fabricated through forging, preferably cold forming. Cold forming is accomplished through the use of a die insert. The die insert is 15 preferably machined to the desired shape using conventional ball end mill techniques. After being forged, the washer body 82 is heat-treated to an average hardness of 36 on the Rockwell C scale.

Referring now to FIGURE 13, the washer body 82 is generally annular in shape and provided with a bearing surface 84. The bearing surface 84 is 20 preferably in a generally frusto-conical in shape, located on the inner end of the washer body 82. In alternative embodiments, the bearing surface 84 is spherically concave, spherically convex, and flat.

The bearing surface 84 of this embodiment is configured to cooperate with an annular surface 72. As depicted in FIGURE 24, the bearing surface 84 is 25 undulating in shape and is preferably provided with an annularly extending series of surfaces, which provide a uniform undulation around the entire bearing surface 84.

FIGURE 31 depicts yet another alternative embodiment of the present invention. As depicted therein, the bearing surface 84 is provided with a plurality 30 of upper peaks of an undulation. The upper peaks are provided as plateaus 118. The plateaus 118 are generally spherically concave

The plateaus 118 are adjacent to a plurality of faces 116. Each plateau 74 is adjacent to a pair of faces 116. The bearing surface 84 of this alternative embodiment is provided with an annularly extending series of faces 116, which form a uniform undulation around the entire surface. The faces 116 are 5 configured to correspond to faces 73 on the annular surface 72. As depicted in FIGURE 31, the faces 116 are generally spherically concave.

Each face 73 is adjacent to a valley 122. Each valley 122 is adjacent to a pair of faces 116. The valleys 122 are configured to be wider than valleys 75 on the annular surface 72.

10 As depicted in FIGURE 31, the valleys 122 are generally spherically concave and have a predetermined depth. In one embodiment, the depth is dimensioned according to the number of threads on the nut. The valleys 122 are formed in the forging process so that they are all concave and lie on the surface of an imaginary sphere whose center is on the axis of the washer body 82. The 15 radius of that sphere ranges from 0.1 inches to 2.00 inches. As such, it will be seen that the plateaus 74 on the nut body 62 are perfectly complementary in shape to the valleys 122 on the washer body 82.

20 The valley 122 and adjacent faces 116 of the alternative embodiment provide an inverted Vee shape profile. The Vee shaped profile provides the plateaus 118 with a height. Advantageously, the height is dimensioned according to the distance between the plateau 74 and the valley 75. In the embodiment shown herein, the height equals the vertical distance between the plateau 118 and the valley 122. The height is preferably slightly greater than the clearance between the threads at 64 and those on a stud 26, when the fastener 25 assembly 50 is in place. In this alternative embodiment, the height ranges between 0 inches and 0.030 inches.

In an alternative embodiment, the height is dimensioned according to the number of threads, measured axially, per inch on the nut. Advantageously the height is related to the number of faces 73 or faces 116. By way of example and 30 not limitation the height, in inches, is proportional to the number of threads per inch and the number of Vee shaped undulations. In the preferred embodiment,

the height is proportional to the product of the number of threads per inch and the number of Vee shaped undulations. The height of this alternative embodiment ranges up to approximately .04167 of an inch.

In the preferred embodiment, washer body 82 is provided with a clamping surface 86. As depicted in FIGURE 13, the clamping surface 86 is provided on the outer end 88 of the washer body 82. In the presently preferred embodiment, the clamping surface 86 is generally flat.

In an alternative embodiment, the washer 54 is provided with a clamping surface 86. The clamping surface 86 is slightly more concave and located on the bottom of the washer 54. The clamping surface 86 forms what approximates a shallow frustum of a cone. The clamping surface 86 is preferably inclined upwardly from the outer periphery 94 of the bottom of the washer flange 92 toward the inner periphery 96 of the body 82. The clamping surface 86 is at an angle 103 with respect to the axis of the nut, depicted in FIGURE 26 as imaginary line C. Angle 103 ranges from 87° to 90°. In this alternative embodiment, the angle 103 is 88°.

In another alternative embodiment, the washer 54 is provided with a plurality of depressions 104. The plurality of depressions 104 provide the clamping surface 86 with clamp segments 106. Advantageously, the clamp segments 106 are configured to flex axially.

Referring to FIGURE 4, the depressions 104 are located on the bottom of the flange 92 and the outer face 88 of the washer body 82. In this alternative embodiment, the depressions 104 extend radially inward from corresponding cut-outs 98. As depicted in FIGURE 4, the clamping surface 86 is provided with six depressions 104 that are generally Vee shaped. However, those skilled in the art will appreciate that any number of depressions may be employed.

In the alternative embodiment depicted in FIGURE 4, the depressions 104 effectively separate the annular clamp surface 86 into six clamp segments 106 that are provided with an arcuate shape. The arcuate outer extremities of the clamp segments 106 are located between the cut-outs 98 and are able to resiliently flex axially of the washer 54.

In an alternative embodiment, the washer 54 is provided with an ear 108. The ear 108 is configured to cooperate with a stud 26. The ear 108 cooperates with a slot 49 provided on at least a portion of the stud 26. The ear 108 is of a size and shape suitable to slide loosely in an axially elongated slot 49 formed on one side of the threaded end section of a stud 26 or spindle 12. The ear 108 preferably cooperates with the slot 49 to prevent the washer 54 from rotating with respect to the stud 26 or spindle 12.

FIGURE 27 depicts an ear 108 extending inward from end face 88 washer body 82. FIGURE 10 depicts the ear 108 extending inwardly of the base of the washer body 82, opposite a flange 92. Referring now to FIGURE 34, the ear 108 is depicted cooperating with a slot 49 on a portion of a stud 26.

Those skilled in the art will appreciate that the invention contemplates the use of other conventional means for preventing washer rotation. In the alternative, a flat may be formed on the stud 26 or a spindle 12 and a corresponding flat formed inwardly of the washer body 82.

FIGURE 25 depicts yet another alternative embodiment of the present invention. As shown therein, the washer 54 is provided with a flange 92. The flange 92 extends outward from the washer body 82. In this alternative embodiment, the flange 92 is between 0.05 inches and 0.12 inches thick.

In another alternative embodiment the flange 92 is provided with a plurality of slots formed inwardly from its outer edge, at regular intervals around the flange 92. The slots permit intervening flange sections 102 to resiliently flex, albeit only slightly, when the clamping surface 86 is forced against a surface and is under the desired load.

FIGURE 5 depicts the flange 92 provided with slots in the form of a plurality of cut-outs 98. The cut-outs 98 provide the flange 92 with a plurality of flange sections 102. Advantageously, the flange sections 102 are configured to flex axially. The flange sections 102 are configured to flex an axial distance which is slightly greater than the clearance between the threads on the stud and the threads on the nut 52.

In the alternative embodiment depicted in FIGURE 5, the cut-outs 98 are generally U shaped. However, in other embodiments, cut-outs 98 are in other shapes such as a circular or polygonal shape.

5 In the alternative embodiment depicted in FIGURE 5, the flange 92 is provided with a plurality of cut-outs 98. The number of cut-outs 98 in the flange 92 are provided according to the size of the flange 92. Advantageously, the number of cut-outs 98 is based upon the thickness of the flange 92. The embodiment depicted in FIGURE 5, is provided with six cut-outs 98, yielding six flange sections.

10 In an alternative embodiment of the present invention, the washer 54 is provided with a clamping surface 86. Referring to FIGURE 32, at least a portion of the clamping surface 86 is located on the flange 92. As shown therein, the clamping surface 86 is located on the bottom of the flange 92 and the outer face 88 of the washer body 82.

15 FIGURE 29 depicts the nut 52 and cap 53 assembled in the preferred embodiment. The nut 52 and cap 53 are preferably assembled by interference fitting the inner surface 81 of the cap 53 around the retaining surface 59. Thereafter, frictional forces acting on frictional surface 55 and frictional surface 70 retain the cap 53 on the nut 52.

20 FIGURE 20 depicts the nut 52 and washer 54 assembled in the preferred embodiment. As depicted therein, the nut 52 and washer 54 are preferably assembled by inserting the skirt 68 into the washer 54, whereby the annular surface 72 is opposed to the bearing surface 84. Thereafter, at least a portion of the collar 85 is forced outward to provide skirt 68. The skirt 68 is configured to
25 underlie a portion of the washer 54, whereby it loosely but securely connects the nut 52 and washer 54, while permitting the nut 52 to rotate freely relative to the washer 54.

FIGURE 15 depicts the preferred embodiment, wherein at least a portion of the skirt 68 underlies an annular inward-projection 83 around its
30 circumference. However, those skilled in the art will appreciate that the collar 85

can be forced outward at space locations, to provide a skirt 68 which underlies a portion of the projection 83.

FIGURE 38 depicts the clamping surface 86 of an alternative embodiment. As shown therein the clamping surface 86 is provided with a plurality of 5 protrusions 30. The protrusions 30 provide the clamping surface 86 with a higher frictional coefficient.

The clamping surface 86 is configured to prevent the washer 54 from rotating. The protrusions 30 frictionally engage the surface that is being fastened to prevent the washer 54 from rotating with respect to the surface. FIGURE 38 10 depicts a clamping surface 86 that is provided with eight (8) protrusions; however, a clamping surface 86 may be provided with more than eight (8) protrusions, such as twelve (12) protrusions.

In the preferred embodiment, the fastener assembly 50 is rotated onto the stud 26. During the rotation the internally threaded nut 52 engages threads on 15 the stud 26, whereby the fastener assembly travels axially toward the wheel hub 20. During this rotation, both the nut 52 and the washer 54 are able to rotate with respect to the stud 26.

Upon further rotation, the clamping surface 86 engages a surface of the wheel hub 20 that is adjacent to the stud 26. Further axial travel of the fastener 20 assembly 50 is resisted by this surface. The resistance is at first relatively slight, however, upon further rotation the resistance increases until the fastener assembly 50 is secured to the stud 26.

However, in alternative embodiments, a fastener assembly 150 can be threaded onto spindle 12. As depicted in FIGURES 1 and 2 the fastener 25 assembly 150 of an alternative embodiment is threaded onto spindle 12. As shown therein, the outer bearing assembly 29 can be held in operating relationship against the shoulder 39 and spacer 41 by a fastener assembly 150 of an alternative embodiment. In this regard, the fastener assembly 150 is threaded onto the threaded outer end section 45 of the spindle 12 and seats 30 against the inner bearing race 47 of the bearing assembly 29.

The fastener assembly 150 is threaded onto the end section 45 of the spindle 12 to take up undesired play in the bearing assemblies 28 and 29 and, accordingly, hold them both in proper operating position and relationship. If the fastener assembly 150 is threaded too snugly against the bearing race 47, the 5 bearing assemblies 28 and 29 will both be over-loaded and their operating life shortened. If the fastener assembly 150 is not threaded sufficiently far onto the end section 45, the bearing assemblies 28 and 29 will have too much play and their operating life will be shortened. The fastener assembly 150 of this 10 alternative embodiment is designed to be turned onto the threaded end section 45 of the spindle 12 to a desired position and then held securely in that position by locking forces exerted internally of the assembly according to the invention.

In an alternative embodiment, the fastener assembly 150 is configured for securing a wheel hub 20 on a stud 26 that is provided as a spindle 12 in an axle assembly 10 of a truck or some other vehicle. For example, after a wheel hub 20 15 has been seated on its supporting bearing assemblies 28 and 29, a fastener assembly 150 is slipped over the threaded end section 45 of the spindle 12 so that the ear 108 in the washer 54 slides along the slot 49 in the spindle 12 until the internal threads 64 engage the external threads on the spindle 12. As the nut 52 rotates while being threaded onto the spindle 12 the washer 54 is pushed 20 freely in front of it without rotating. In this way, the washer 54 moves axially with it but is prevented from rotating because its ear 108 is axially slidable in, but rotationally fixed by, the slot 49 in the spindle 12.

All the while, the nut 52 and washer 54 are seated against each other in nested relationship. In this nested relationship, each plateau 74 will seat 25 uniformly on a corresponding valley 122 while opposed inclined faces 73 and 116 will be slightly separated. In this relationship, the peaks, provided as plateaus 74 and plateaus 118, on the annular surface 72 and bearing surface 84, respectively, ride over each other. As such, the annular surface 72 slips easily over the bearing surface 84 on the washer 54 as the nut 52 pushes the washer 30 54 before it.

The nut 52 is further threaded onto the spindle 12 by hand until the clamp surface 86 on the washer body 82 engages the inner bearing race 47. When the clamp surface 86, having a frusto-conical shape, engages the inner bearing race 47, further rotation of the nut is resisted.

5 The resistance is at first relatively slight, however, upon further rotation the resistance increases. As such, the peaks ride over each other with greater and greater difficulty as the load increases. The resistance increases with greater and greater effect by the interlocking effect of the faces 73 on the nut 52 and the faces 116 on the washer 54. Eventually, they can slip past each other only when
10 the flange sections 102 on the washer 54 begin to resiliently flex. As the nut turns and axial pressure builds up in the bearing assemblies 28 and 29. As this pressure builds, the flange sections 102 begin to flex.

15 The flange sections 102 are designed to resiliently flex through an axial distance which is slightly greater than the clearance between the spindle 12 threads and the nut body 62 threads. Because the flange sections 102 are able to flex slightly more than this clearance, the washer 54 can move axially under load to some degree without degradation of the lock between washer 54 and nut 52. At the same time, because the height of the plateau 118 above the valley 122 in the washer body 82 is slightly greater than the clearance also, once a
20 locking relationship is established with the proper preload the nut 52 and washer 54 can move slightly relative to each other without loosening the fastener assembly 150.

25 The flexing creates a resilient force tending to keep the faces 73 on the nut 52 and the faces 116 washer 54 in an interlocked relationship. In this locked relationship, a constant bearing load is resiliently maintained and the peaks of the nut 52 and washer 54 are seated generally flush against corresponding valleys 122 and valleys 75, respectively. Also, the faces 73 seat generally flush against the faces 116 and prevent the fastener assembly 150 from backing off. In particular, the leading faces 73 seat against trailing faces 116. Moreover,
30 because the faces 73 and faces 116 are preferably provided so as to be complementarily spherically convex and spherically concave, respectively, and

all their radii of curvature axially of the fastener assembly 150 and from its axis equal those of the aforementioned valleys 122, locking surface contact is maintained between them even if the nut 52 and washer 54 are not precisely parallel to each other because the nut does not thread perfectly square onto the

5 spindle 12.

When a predetermined torque setting is reached in turning the nut 52 of the locking assembly 50 onto the spindle 12, the bearing assemblies 28 and 29 are properly preloaded. The locking assembly 50 can then be relied upon to resist all axial forces tending to cause the nut 52 to back off. Increased axial load
10 from the wheel hub 20 merely causes the nut 52 and washer 54 to become more securely locked together. Only by applying loosening torque to the nut 52 again, as with a hex wrench, can the fastener assembly 150 be removed.

Although the alternative embodiment of this invention has been described in the context of a vehicle wheel hub mounting arrangement, it should be
15 understood that it might be otherwise employed. Its simplicity, rugged construction, virtually fail-proof action, and low manufacturing cost may make it very attractive in many applications.

While a preferred embodiment of the invention has been described, it should be understood that the invention is not so limited, and modifications may
20 be made without departing from the invention. The scope of the invention is defined by the appended claims, and all devices that come within the meaning of the claims, either literally or by equivalence, are intended to be embraced therein.

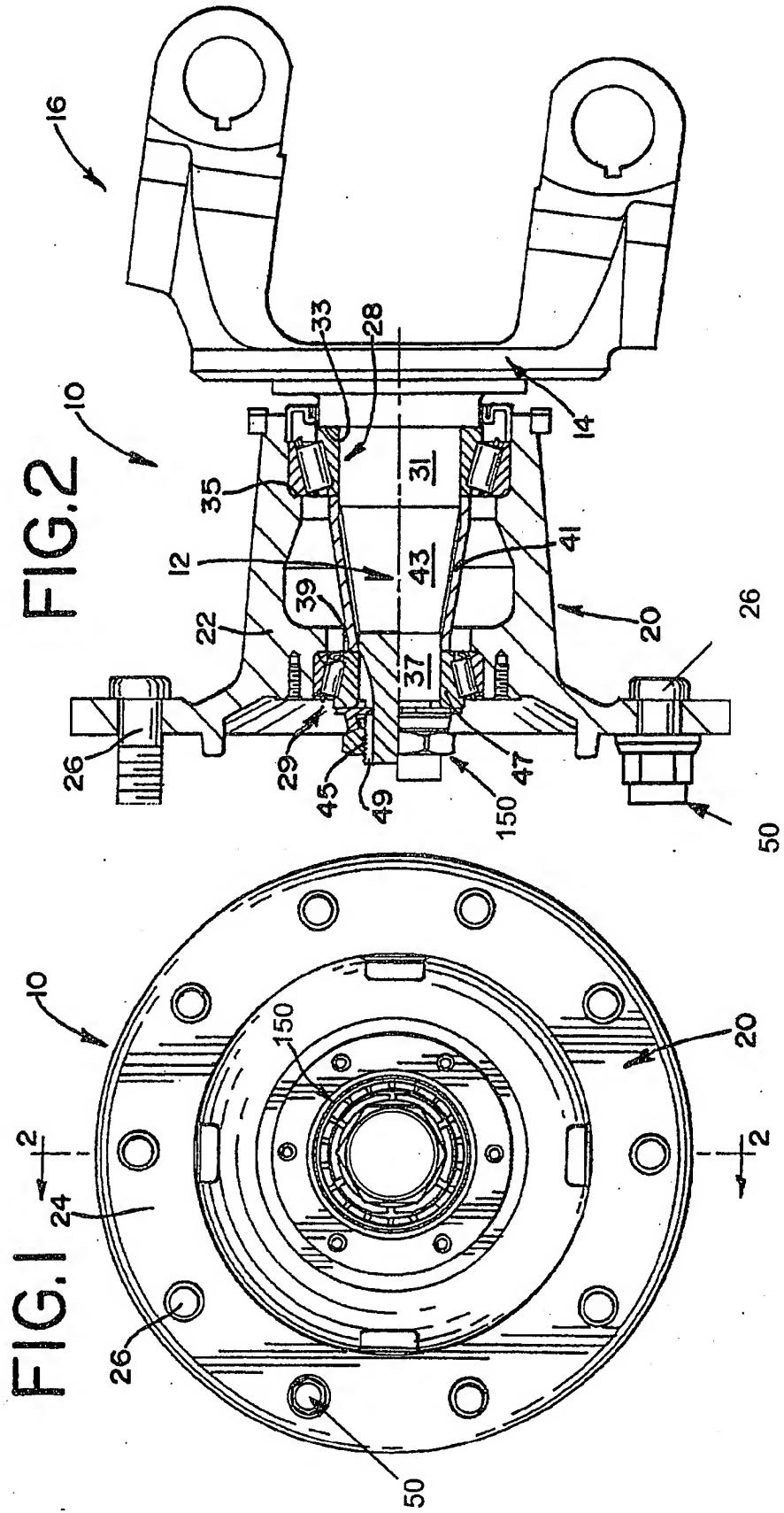


FIG.3

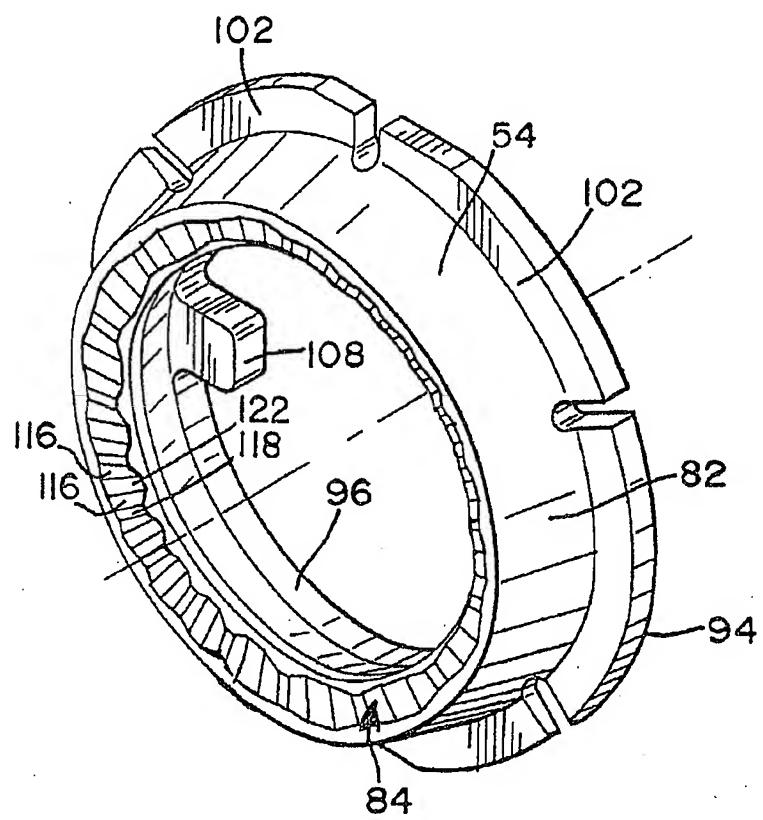


FIG.4

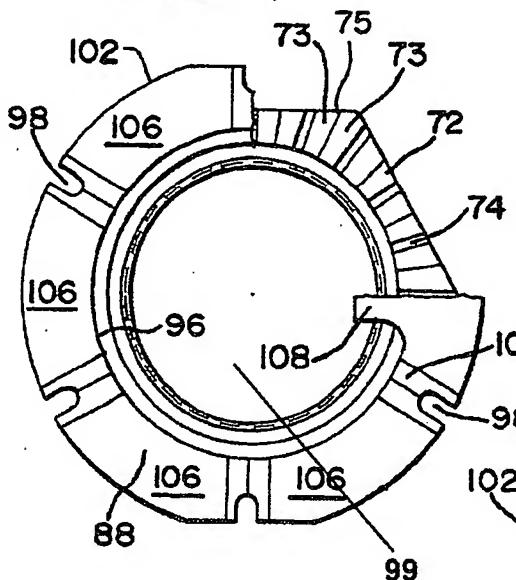


FIG.5

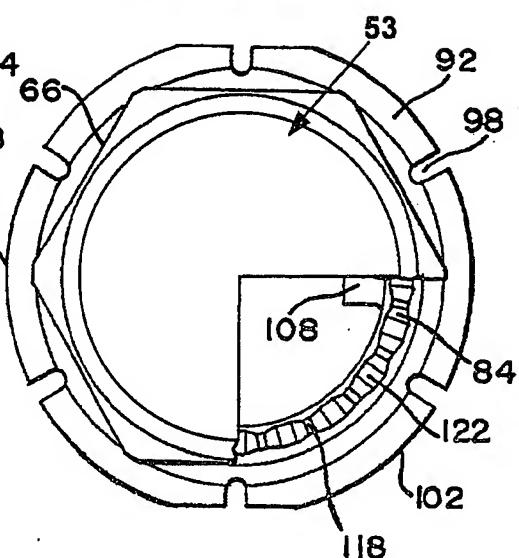


FIG.6

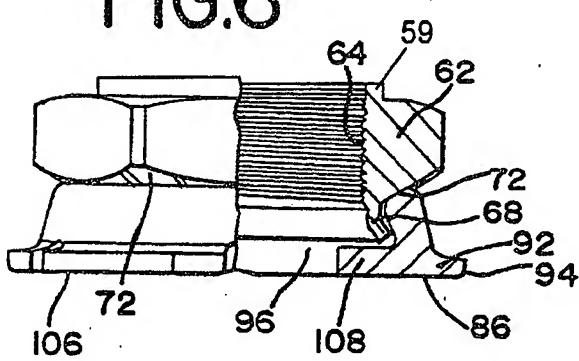


FIG.7

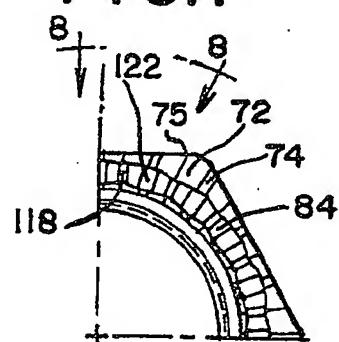


FIG.8

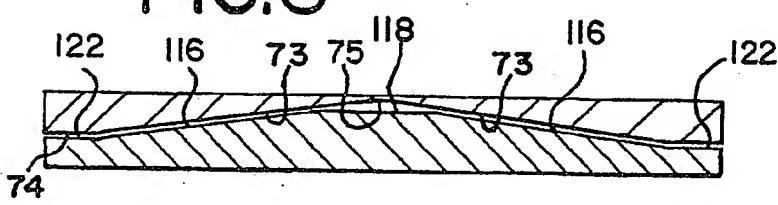


FIG.9

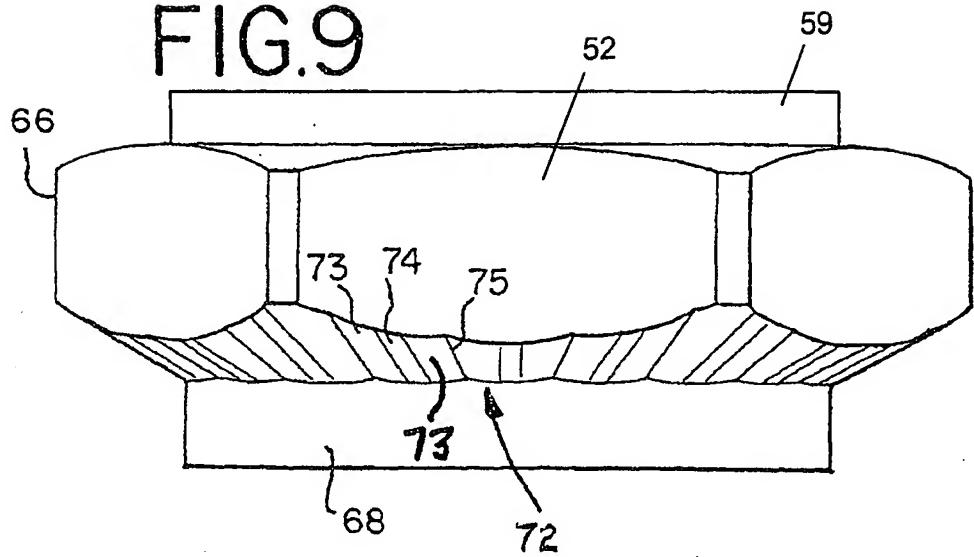


FIG.10

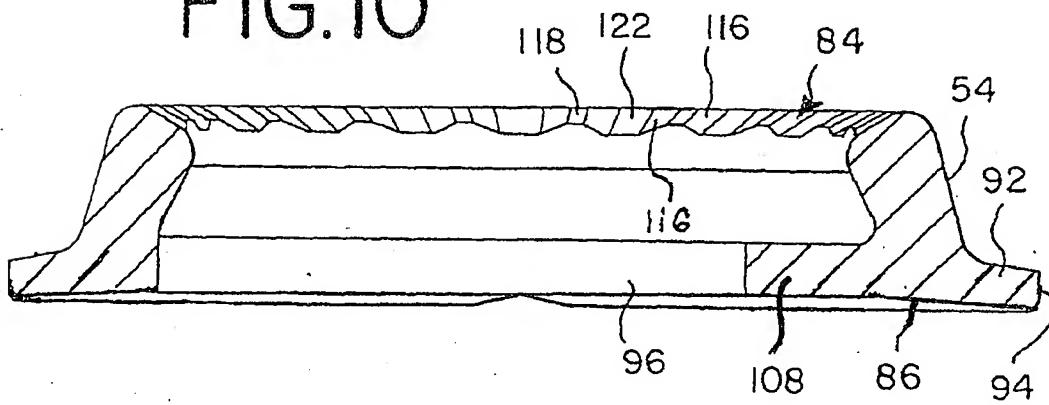


FIG.11

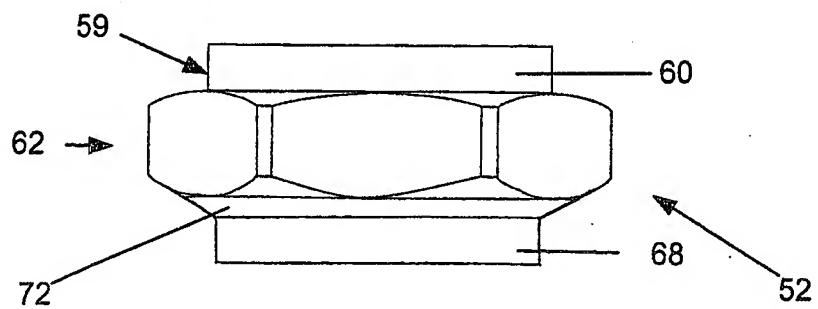


FIG.12

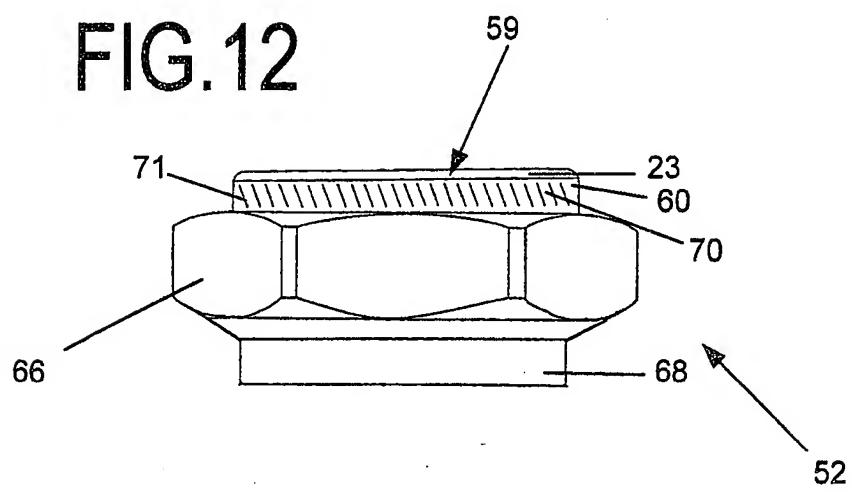


FIG.13

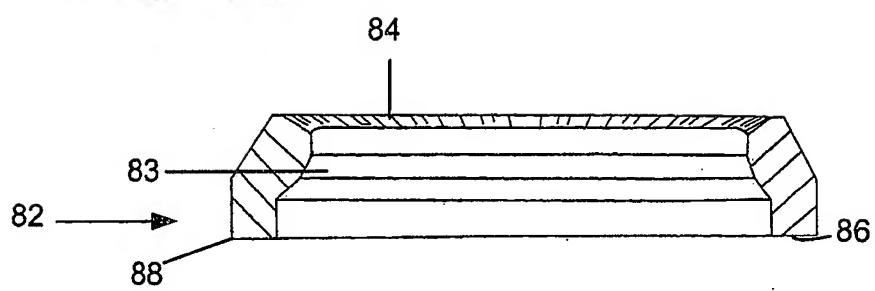


FIG. 14

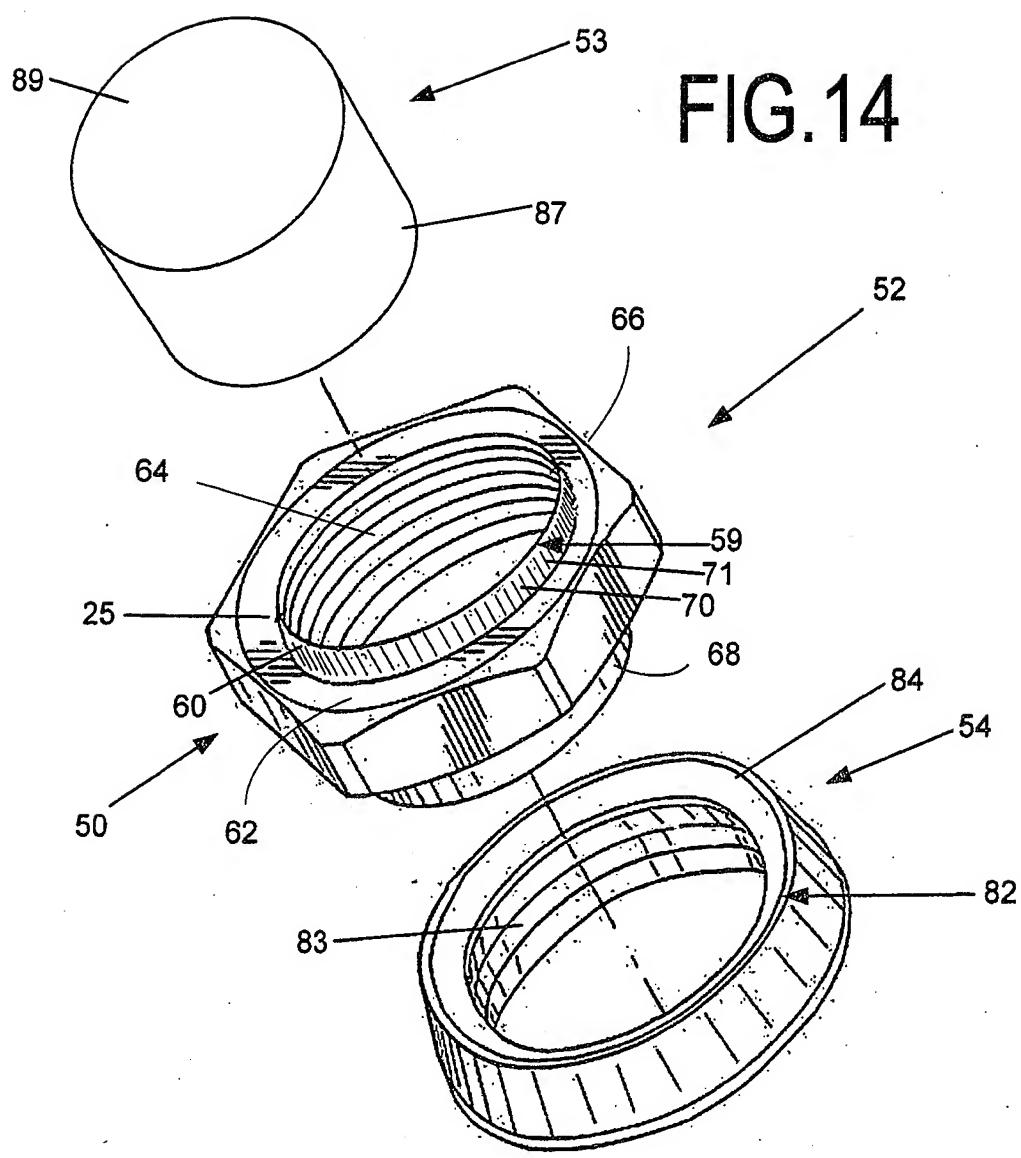


FIG.15

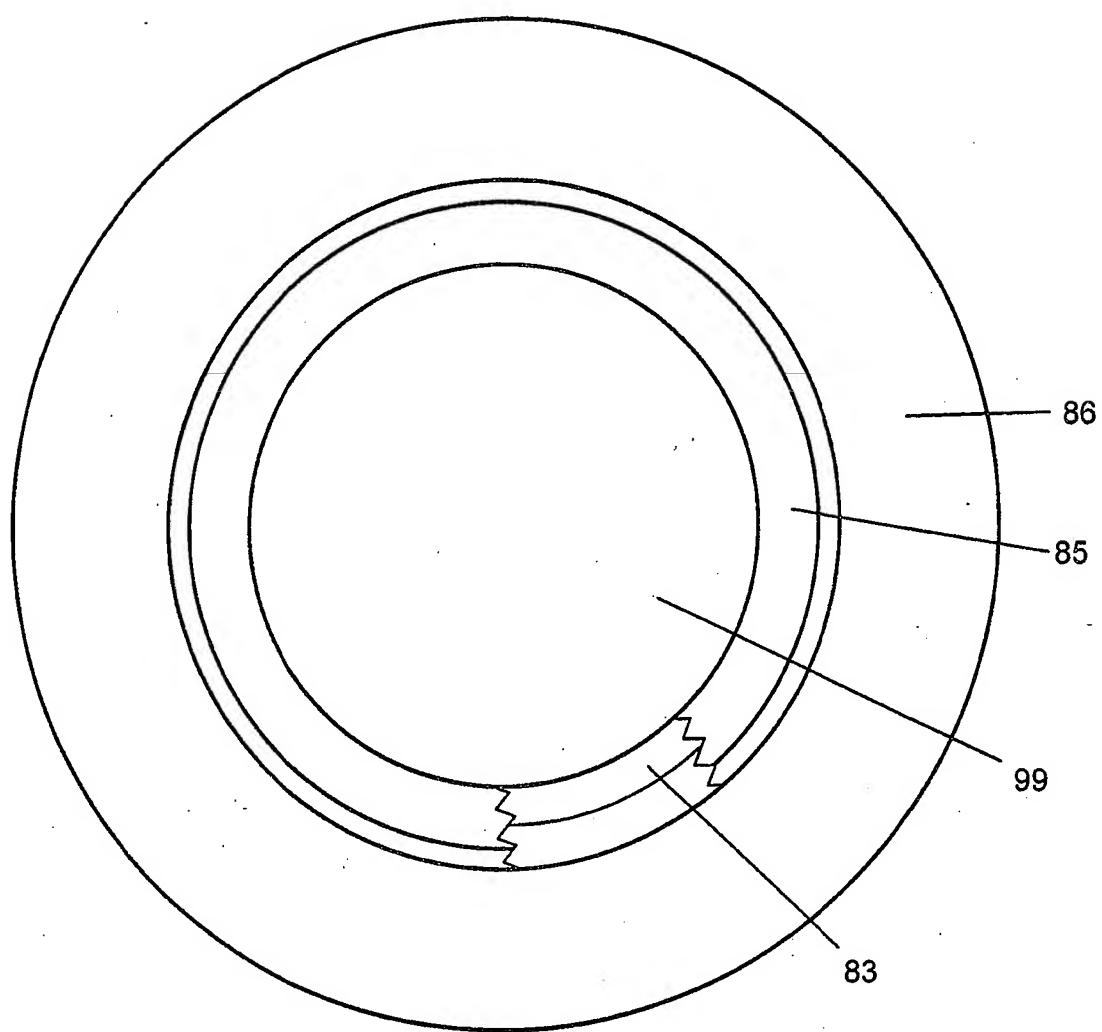


FIG.16

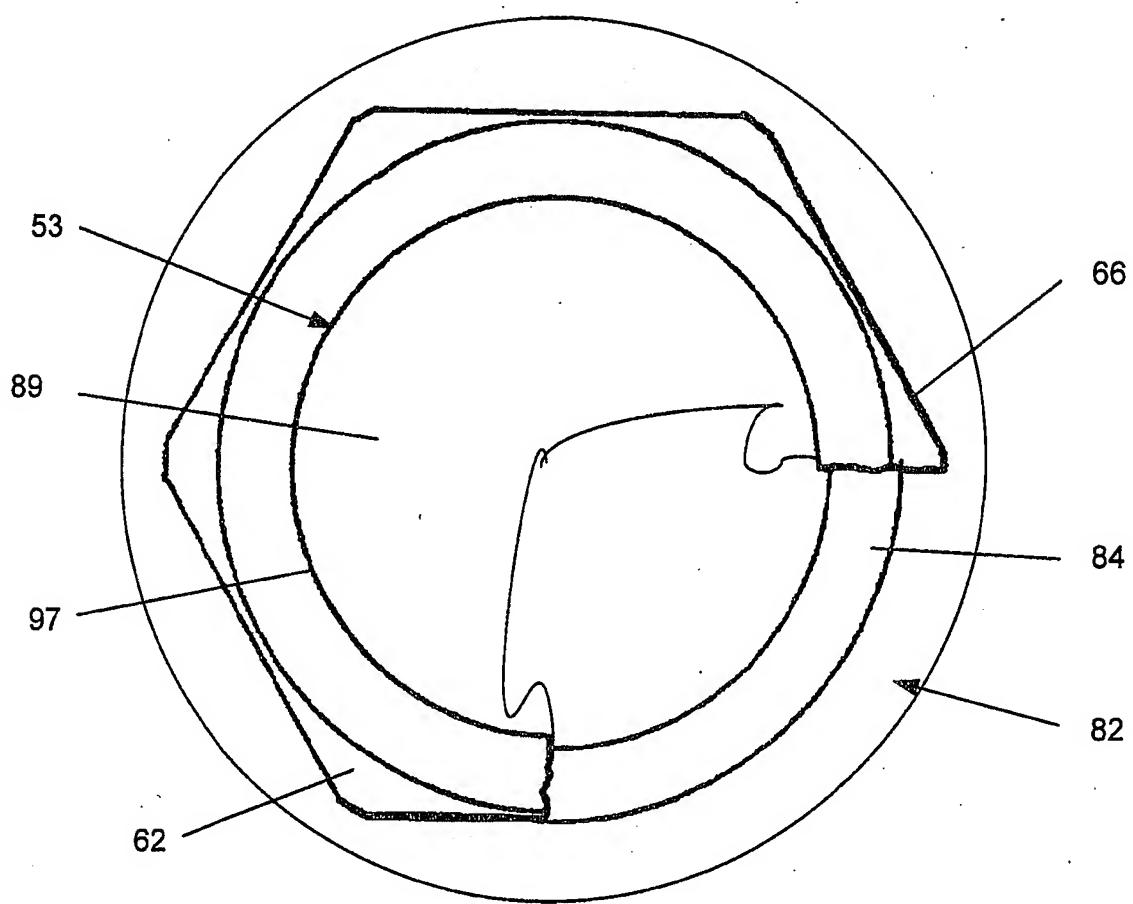


FIG.17

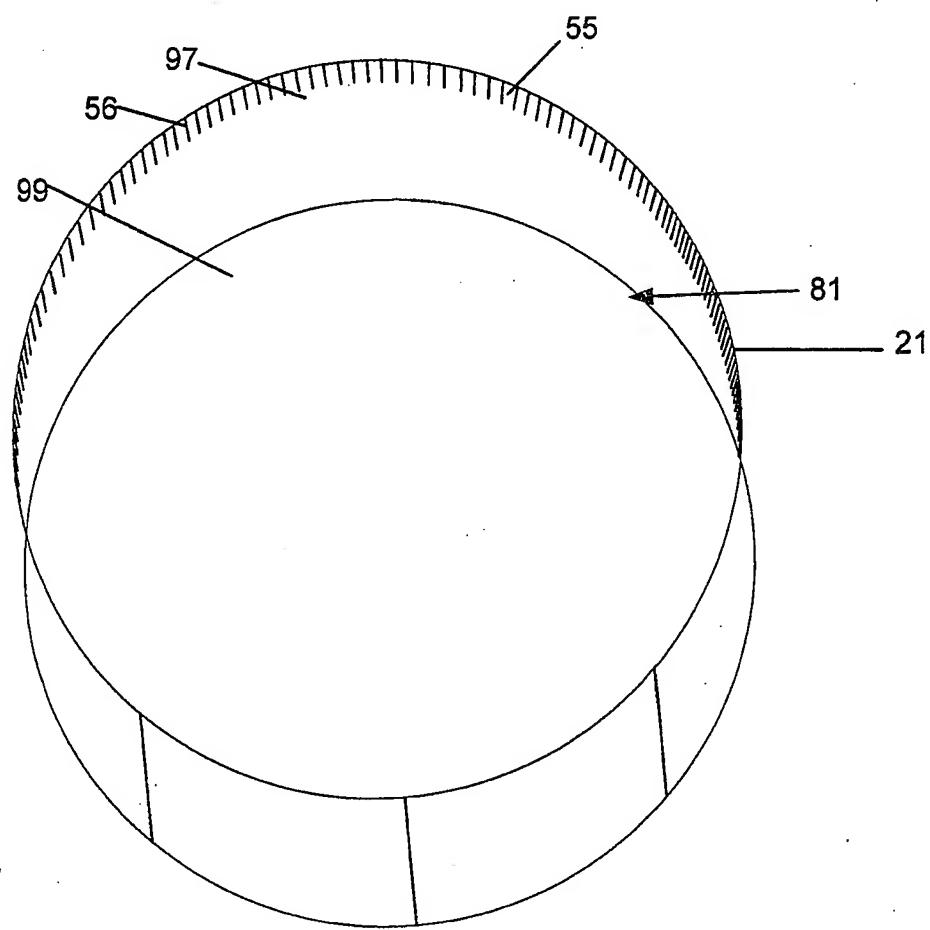


FIG.18

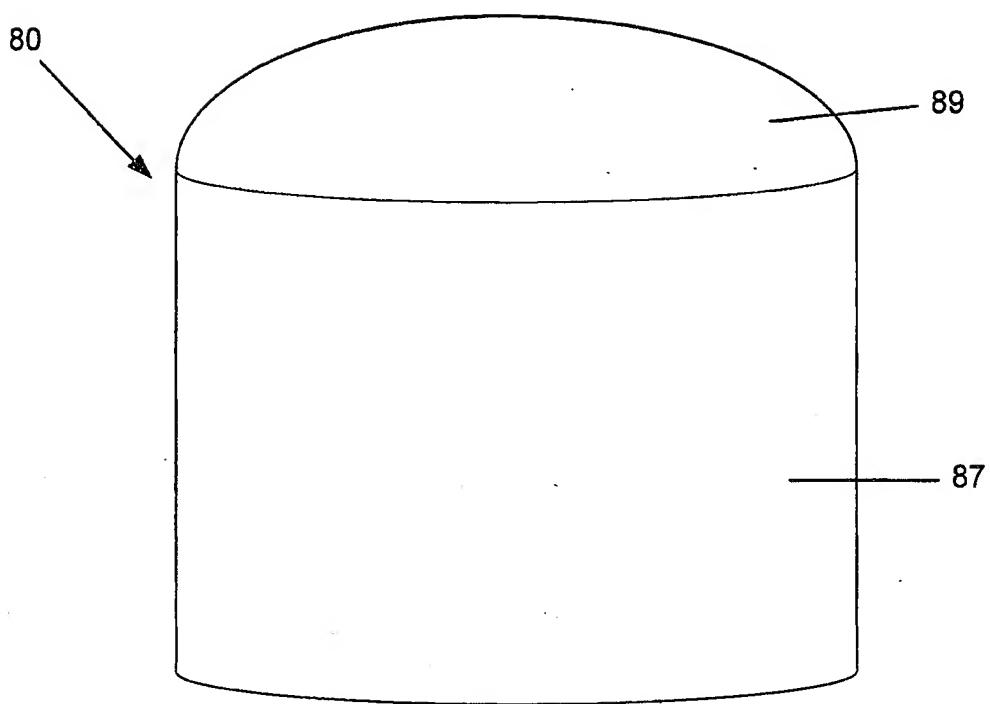


FIG.19

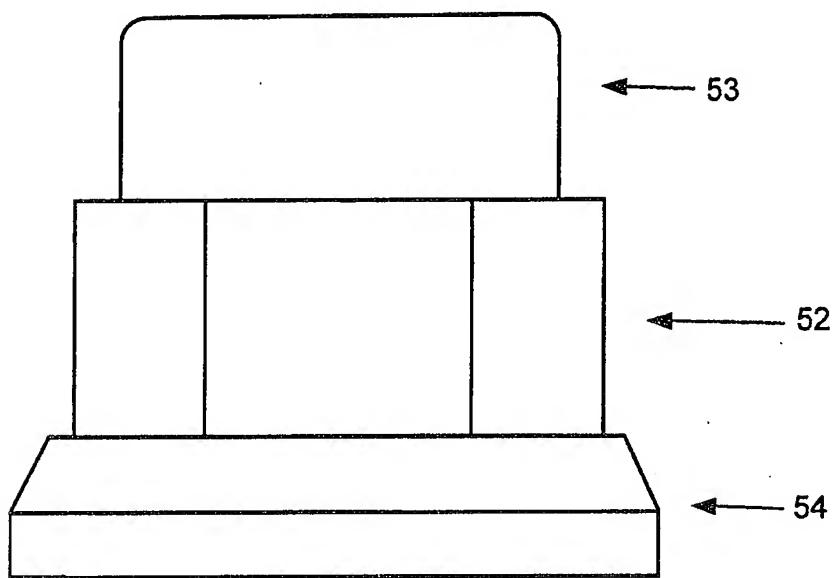


FIG.20

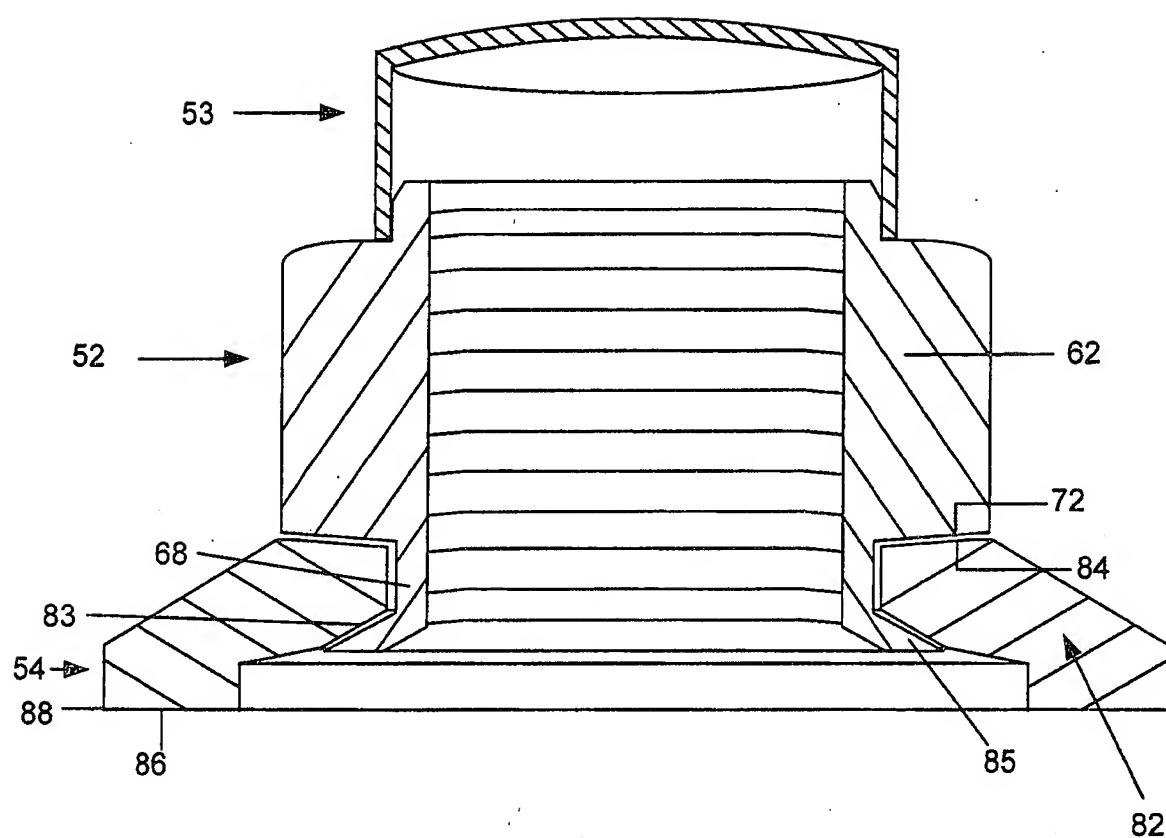


FIG.21

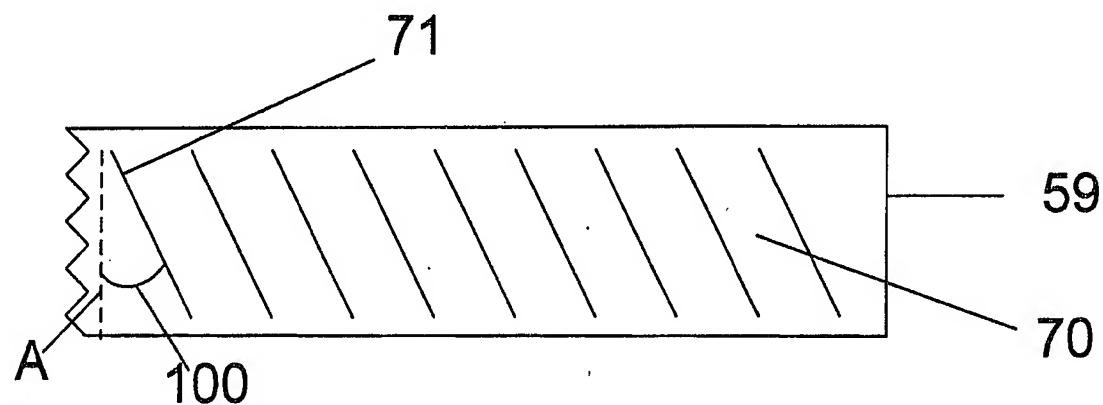


FIG.22

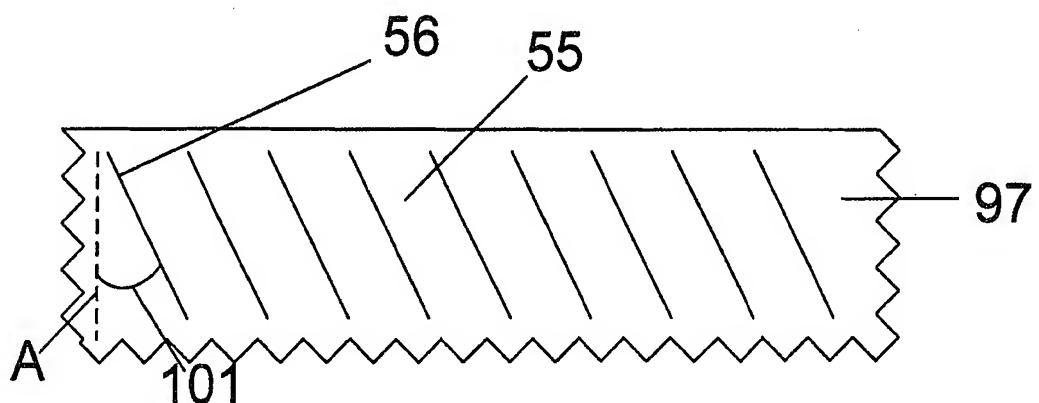


FIG.23

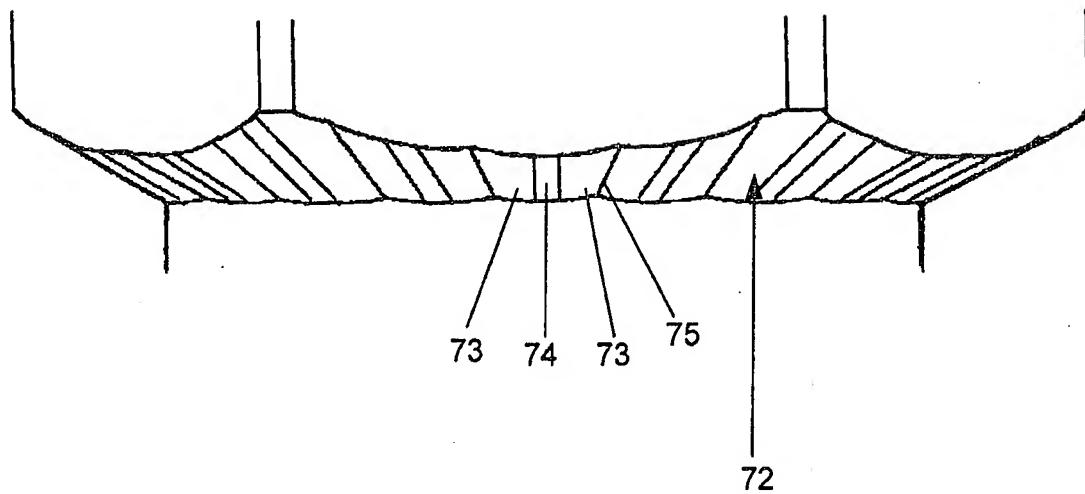


FIG.24

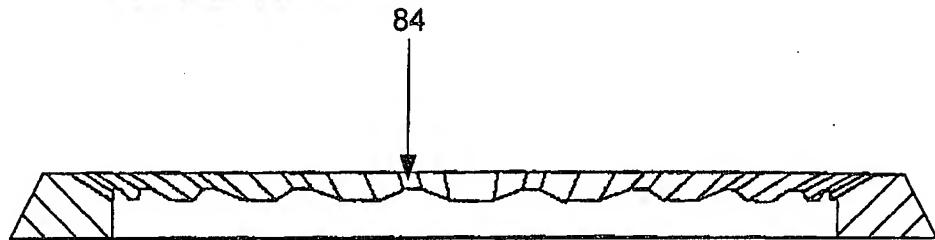


FIG.25

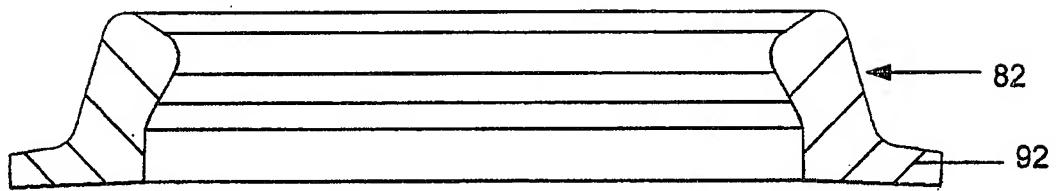


FIG.26

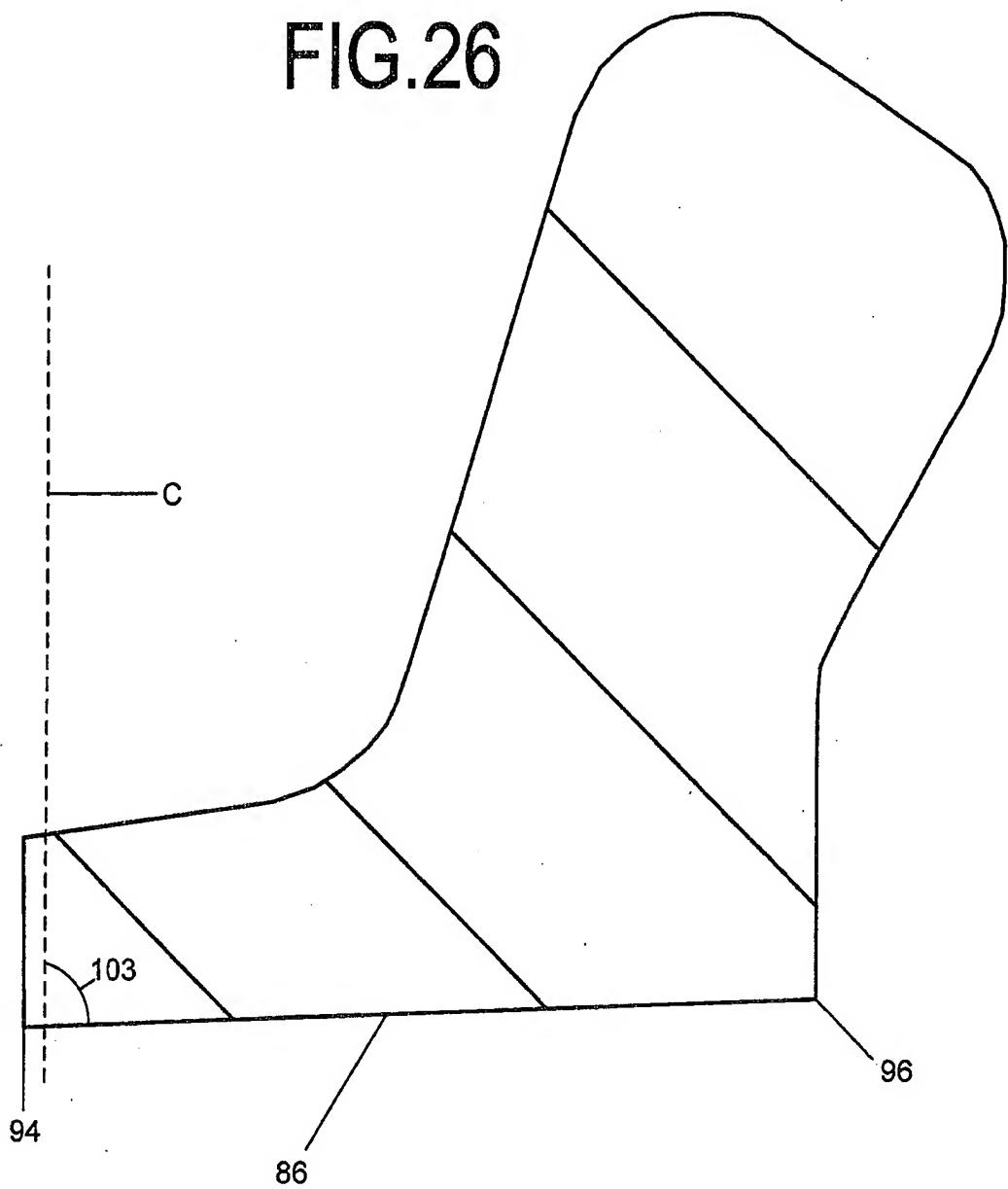


FIG.27

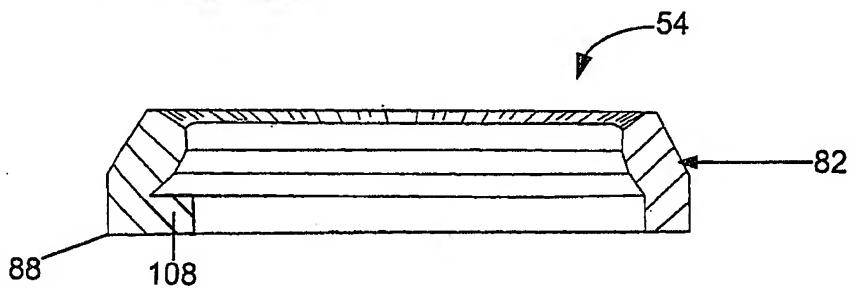


FIG.28

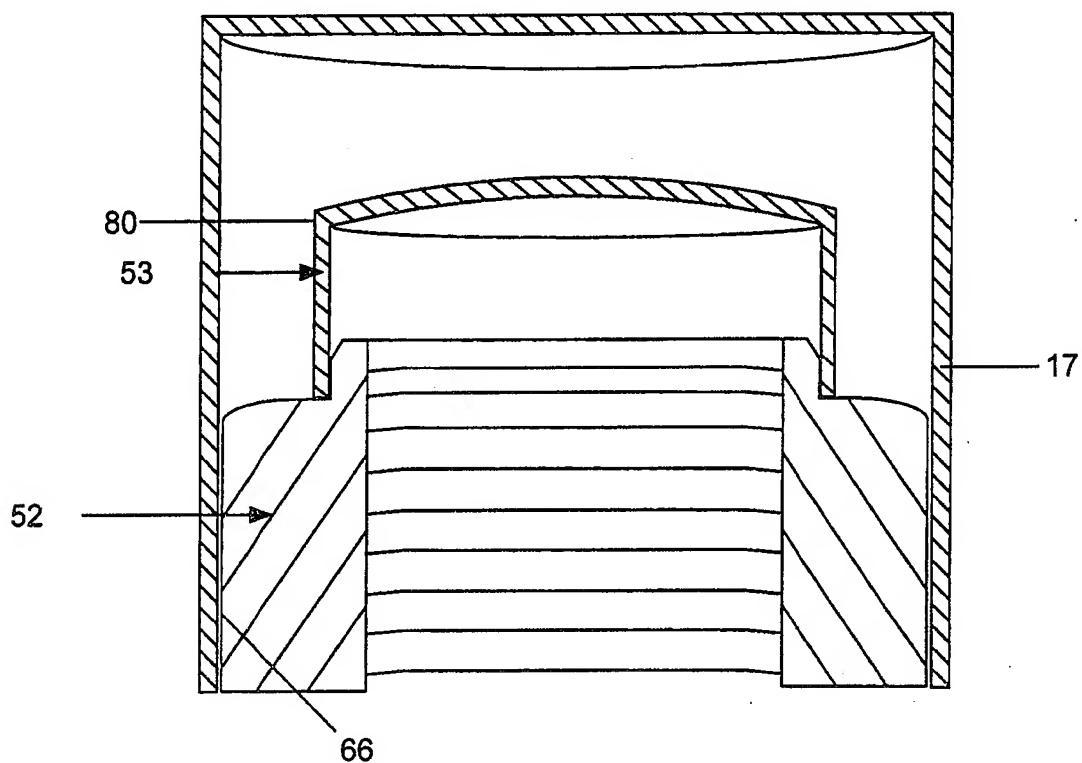


FIG.29

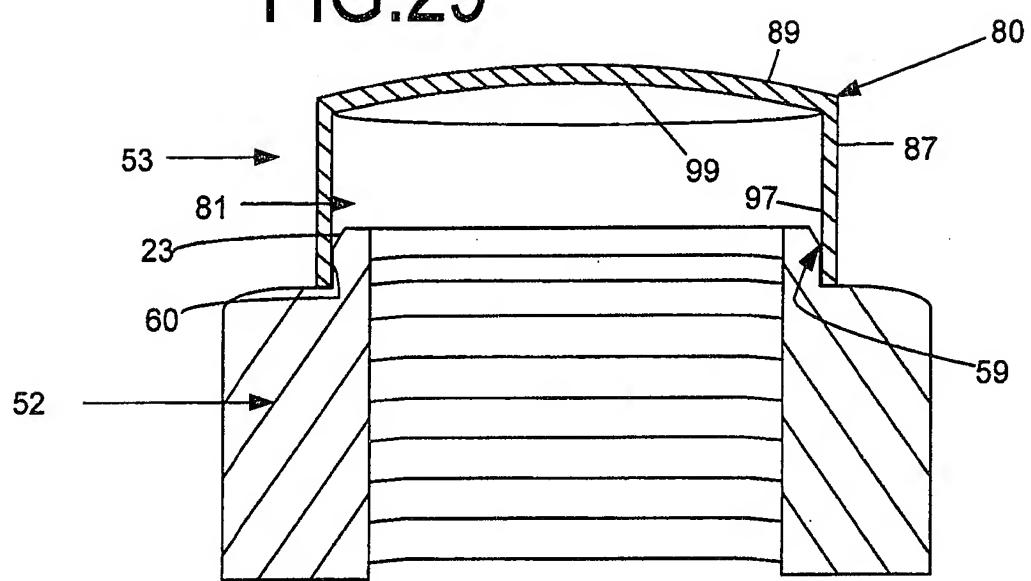


FIG.30

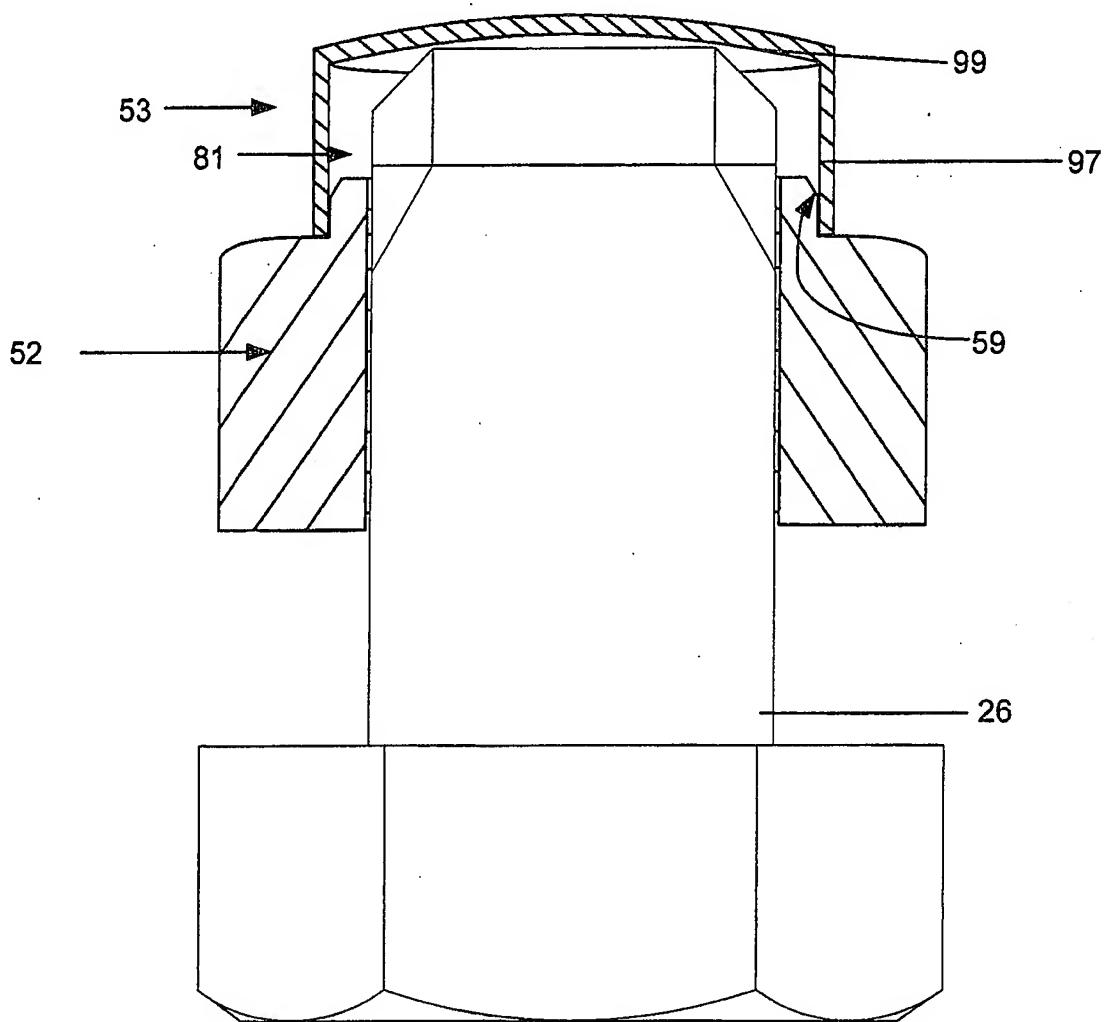


FIG.31

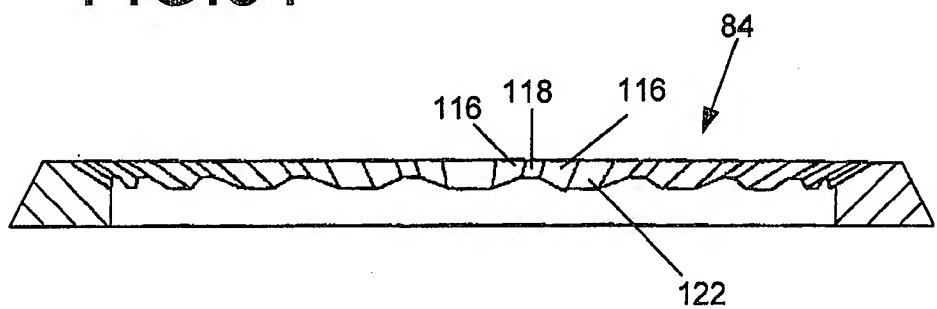


FIG.32

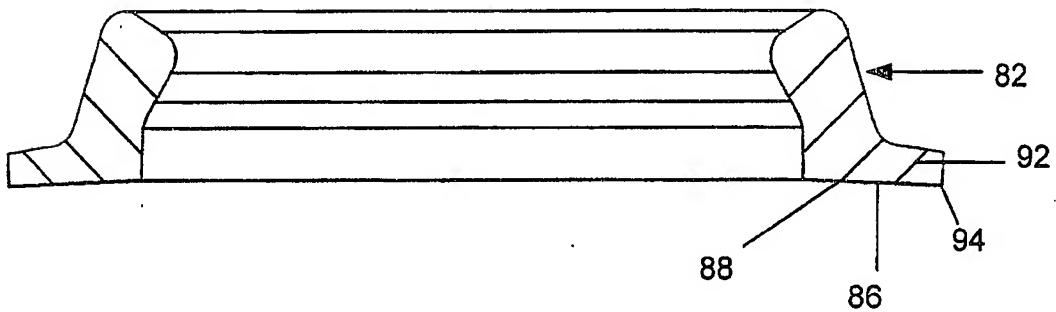


FIG.33

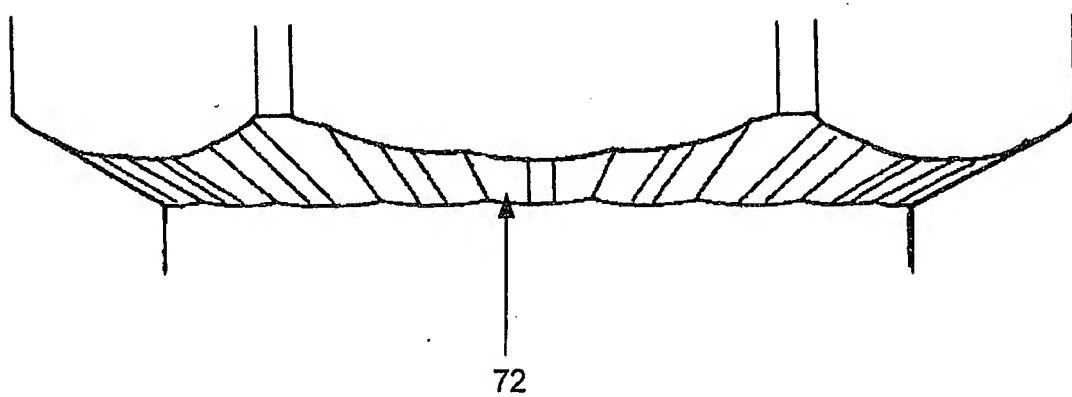


FIG.34

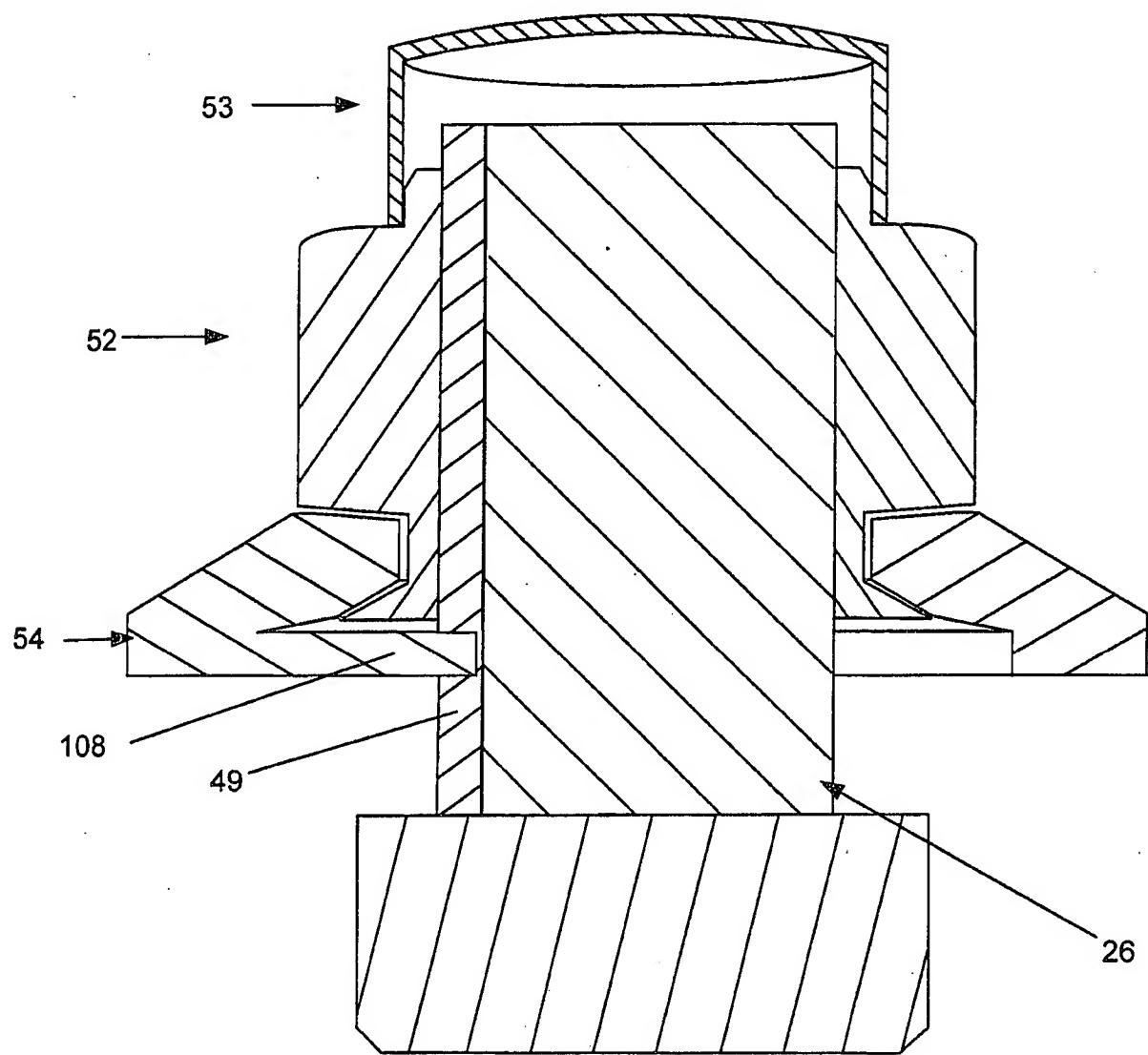


FIG.35

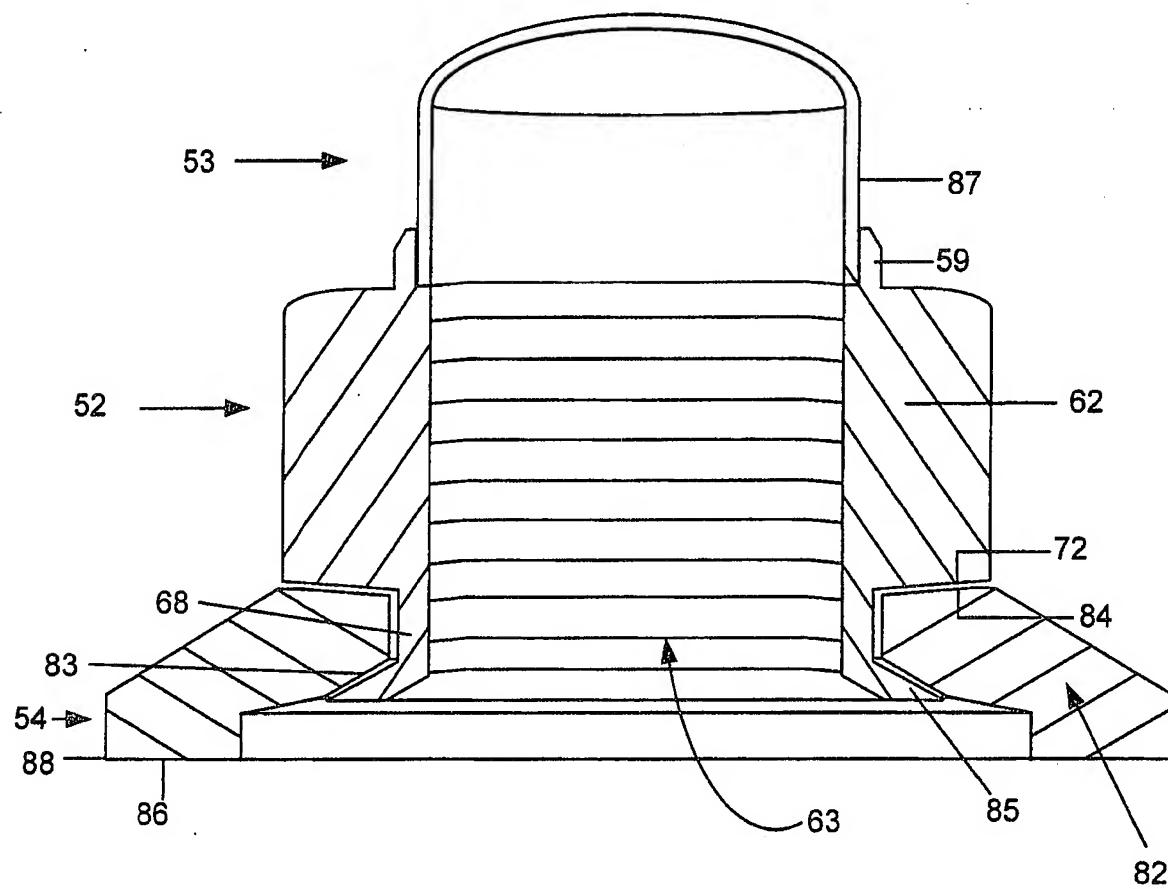


FIG.36

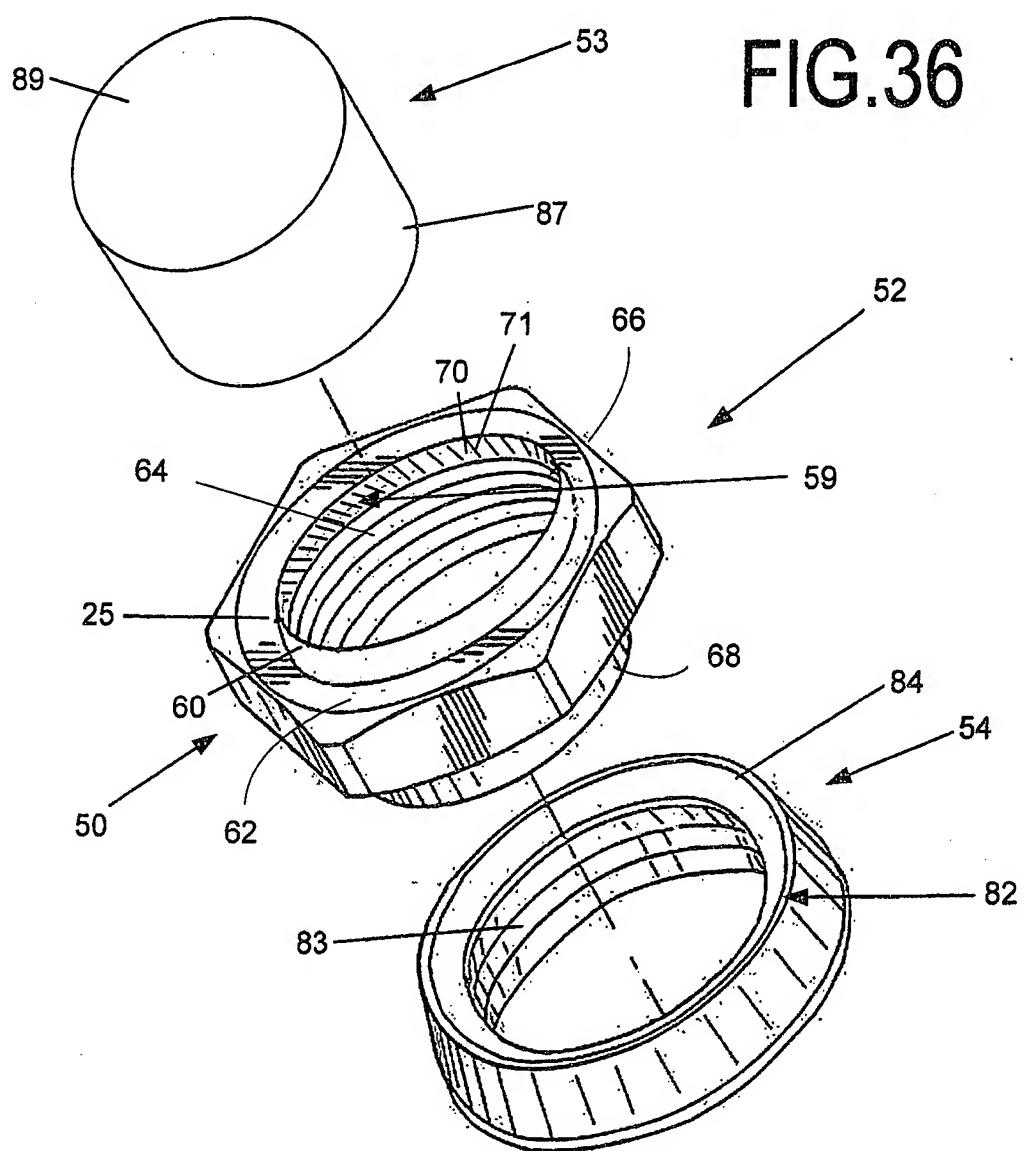


FIG.37

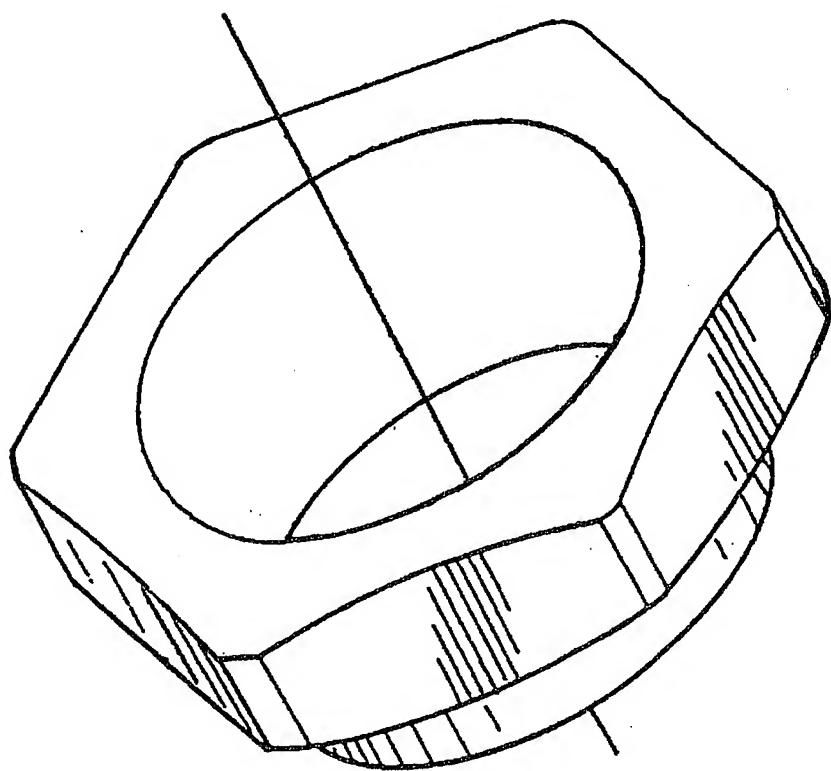


FIG.38

